PG and Research Department of Chemistry, Jamal Mohamed College (Autonomous)

M.Sc. Chemistry

SEM	Course Code	Course	Course Title	Ins. Hrs / Week	Credit	Marks		Total
						CIA	ESE	
I	20PCH1CC1	Core – I	Ionic, Coordinate Solids, Metallurgy and Nuclear reactions	6	5	25	75	100
	20PCH1CC2	Core – II	Organic Reaction Mechanisms, Reagents and Natural Products	6	5	25	75	100
	20PCH1CC3P	Core – III	Inorganic Estimation and Complex Preparations - Practical	6	4	20	80	100
	20PCH1CC4P	Core – IV	Organic Preparations and Estimation - Practical	6	4	20	80	100
	20PCH1DE1A/B	DSE –I#		6	4	25	75	100
		TOTAL		**30**	**22**			**500**
II	20PCH2CC5	Core – V	Organic Reactions, Stereochemistry and Natural Products	6	5	25	75	100
	20PCH2CC6	Core – VI	Theory and Applications of Group Theory and Spectroscopy	6	5	25	75	100
	20PCH2CC7P	Core – VII	Inorganic Qualitative Analysis and Colorimetric Estimations - Practical	6	4	20	80	100
	20PCH2CC8P	Core – VIII	Qualitative Analysis of Organic Mixture and Chromatography Techniques - Practical	6	4	20	80	100
	20PCH2DE2A/B	DSE–II #		6	4	25	75	100
		TOTAL		**30**	**22**			**500**
III	20PCH3CC9	Core – IX	Solid State, NMR, ESR, Photoelectron Spectroscopy and Bio-Medicinal Chemistry	6	5	25	75	100
	20PCH3CC10	Core – X	Organic Spectroscopy and Natural Products	6	5	25	75	100
	20PCH3CC11	Core – XI	Industrial Chemistry	6	4	25	75	100
	20PCH3CC12P	Core – XII	Physical Chemistry Non-Electrical - Practical	6	4	20	80	100
	20PCH3DE3A/B	DSE –III#		6	4	25	75	100
	20PCH3EC1	Extra Credit Course-I	Online Course (MOOC)	-	1*	-	-	-
		TOTAL		**30**	**22**			**500**
IV	20PCH4CC13	Core – XIII	Classical, Statistical Thermodynamics and Surface Phenomena	6	5	25	75	100
	20PCH4CC14	Core – XIV	Chemistry of Macromolecules	6	5	25	75	100
	20PCH4CC15P	Core – XV	Physical Chemistry Electrical- Practical	6	5	20	80	100
	20PCH4DE4 A/B	DSE –IV#		6	4	25	75	100
	20PCH4PW	Project		6	4	-	100	100
	20PCH4EC2	Extra Credit Course-II	Chemistry for Career Examinations	-	5*	-	100	100*
	20PCNOC	Online Course (Compulsory)		-	1	-	-	-
		TOTAL		**30**	**24**			**500**
			GRAND TOTAL	**120**	**90**			**2000**

***Not considered for grand total and CGPA**

#Discipline Specific Electives

Semester	Course Code	Course Title
I	20PCH1DE1A	Quantum Chemistry, Kinetics of Solutions and Electrodes
	20PCH1DE1B	Quantum Chemistry and Spectroscopy
II	20PCH2DE2A	Chemistry of Complexes and Organometallics, IR, Electronic and Mossbauer Spectroscopy
	20PCH2DE2B	Spectroscopy of Inorganic Complexes and Organometallics
III	20PCH3DE3A	Medicinal Chemistry
	20PCH3DE3B	Chemistry of Materials
IV	20PCH4DE4A	Green and Nano Chemistry
	20PCH4DE4B	Environmental Chemistry and Quality Control

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1CC1	Core – I	IONIC, COORDINATE SOLIDS, METALLURGY AND NUCLEAR REACTIONS	6	5	100	25	75

Course Outcomes (COs):

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

CO1: Examine the crystal type and defects.

CO2: Solve CFSE for co-ordination compounds.

CO3: Design various processes in extraction of metals and manufacture of alloys.

CO4: Apply various concepts of acids and bases to interpret the types of materials.

CO5: Investigate radioactivity using detectors and analyze various nuclear reactions.

UNIT– I **18 hours**

Crystal Structure

1.1 Packing of ions in crystals - Radius ratio rules – Calculation of limiting ratios for coordination number 3 to 6. Classification of ionic structures - AX type (ZnS, NaCl, NiAs, CsCl) and AX_2 type (CaF_2, TiO_2, CdI_2) - structures only.

1.2 Defect in crystals: #Schottky and Frenkel defects# - stoichiometric and non-stoichiometric - Metal excess defects - F-Centre. Metal deficiency defects – Positive ion deficiency – extra interstitial negative ions. Semiconductor systems isoelectronic with silicon and their applications – as transistors, as photovoltaic cells. Superconductors – high temperature super conductors.

1.3 Lattice energy - Born-Lande equation – significance, Kapustinski equation.

UNIT– II **18 hours**

Covalent and coordinate bonds

2.1 Covalent bond - M.O. theory – Symmetry and overlap – construction of molecular orbitals in homo and hetero nuclear diatomic molecules. Isoelectronic molecules and ions.

2.2 Coordinate bonds - Crystal field theory – Splitting of d-orbitals in O_h Symmetry – Strong and weak fields – CFSE – Calculation. Splitting in Td symmetry and tetragonal symmetry – Jahn-Teller distortion - splitting pattern in square planar. #Factors affecting the magnitude of 10 Dq value# - Nature of the ligands - Spectrochemical series, Jorgensen's relation. π bonding and MO theory - Ligands with filled and empty π orbitals – Nephelauxetic effect.

UNIT – III **18 hours**

3.1. Extraction and Uses of Metals: Metallurgy of Zr, Ge, Th and U – #uses of their important compounds#

3.2. Alloys and Intermetallic Compounds: Effect of alloying, types of alloys – simple mixtures, solid solutions, substitutional alloys, interstitial alloys, Intermetallic compounds – Hume-Rothery's rules. Ferrous alloys – Definition, properties and uses. Non-ferrous alloys – types, applications.

3.3. Inorganic polymers: Phosphorous based network polymers – ultra phosphate

glasses, borophosphate glasses - Applications. Coordination polymers - natural and synthetic coordination polymers.

3.4. Rings: Preparation and Structure of Borazines & Phosphazenes – Craigg and Paddock model - Dewar model – Preparation and Structure of sulphur-nitrogen ring system (S_4N_4, $N_4S_4F_4$)

UNIT-IV **18 hours**

Acids & Bases and solvents

4.1. Non-protonic concepts of acid-base reactions – Lux-Flood concept - Usanowich concept. Hard and soft acids and bases (HSAB Principle) – Classification, acid and base strength of hardness and softness – electro negativity of hardness and softness – applications of HSAB, Symbiosis. Differentiating and leveling solvents.

4.2. Solvents general behavior, P.T of ionizing solvents, classification- protic and aprotic solvents - liq. NH_3, SO_2, CH_3COOH, BrF_3 and #HF#.

UNIT– V **18 hours**

Nuclear Reactions

5.1. Radioactivity - orbital electron capture, nuclear isomerism, internal conversion.

5.2. Detection and determination of radioactivity: Nuclear radiation – Scintillation and Cherenkov Counter. Particle accelerators: Linear, Cyclotron, Synchrotron, Betatron and Bevatron - #Nuclear reactors#

5.3. Reactions - Transmutation, stripping and pick-up, spallation, fragmentation and scattering reactions – Sources of neutrons – Neutron activation and isotopic dilution analysis – applications.

……. # - Self Study Portion

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	J. D. Lee	A New Concise Inorganic Chemistry	5th Edition	Oxford University Press	2011	I
2	Wahid U. Malik, G. D. Tuli and R. D. Madan	Selected Topic in Inorganic Chemistry	Reprint	S. Chand & Co., New Delhi	2011	II & IV
3	Gurdeep Raj	Advanced Inorganic Chemistry-Vol.-I	32nd Edition	Krishna's Educational Publishers	2014	III
4.	H.J. Arnikar	Essential of Nuclear Chemistry	4th Edition	New Age International Publishers	2011	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Cotton and Wilkinson	Advanced Inorganic Chemistry	6th Edition	John Wiley & Sons, New York	2004	I & IV
2.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter	Inorganic Chemistry Principles of Structure and Reactivity	4th Edition	Pearson Education, 11th Impression	2011	II & III
3.	Bodie E. Douglas D. McDaniel and John Alexander	Concepts and Models of Inorganic Chemistry	3rd Edition	Wiley India Pvt. Ltd., New Delhi	2006	I
4.	Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong	Inorganic Chemistry	4th Edition	Oxford University Press, New Delhi	2010	IV
5.	Maheswar Sharon and Madhuri Sharon	Nuclear Chemistry	Reprint	Ane books Pvt. Ltd., New Delhi	2021	V

Web References: https://nptel.ac.in/content/syllabus_pdf/104101121.pdf

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits
I	20PCH1CC1	IONIC, COORDINATE SOLIDS, METALLURGY AND NUCLEAR REACTIONS	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓		✓	✓
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓		✓	✓		✓	✓
CO5	✓	✓	✓	✓		✓	✓		✓	✓
Number of Matches = 42, Relationship : High										

Prepared by:

1. Dr. K. Loganathan
2. Dr. N. Mujafarkani

Checked by: Dr. A. Jamal Abdul Nasser

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1CC2	Core – II	ORGANIC REACTION MECHANISMS, REAGENTS AND NATURAL PRODUCTS	6	5	100	25	75

Course Outcome (COs):

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

CO1: Apply the IUPAC nomenclature for different types of organic compounds.

CO2: Formulate the reagents used for the synthesis of novel organic compounds.

CO3: Analyse the role of substrate, solvent, attacking nucleophile in the nuclophilic and electrophilic substitution reactions.

CO4: Categorize different types of addition and elimination reactions.

CO5: Examine the structure of steroids, carotenoids, flavones and their related compounds

UNIT–I **18 hours**

NOMENCLATURE AND REACTION MECHANISM

1.1. Nomenclature of organic compounds: Nomenclature of alicyclic – #monocyclic#, bicyclic and tricyclic. Nomenclature of heterocycles, having not more than two hetero atoms such as oxygen, nitrogen and sulphur, allenes, spirenes and spiro compounds.

1.2. Reaction intermediates: Singlet oxygen, nitrenes and benzyne – generation, stability, structure and reactivity. Non-classical carbo cations definition, generation and stability.

1.3. Methods of determining reaction mechanism:

Energy profile diagrams - Thermodynamic and kinetic control of organic reactions – intermediate versus transition state - isotopic effects – kinetic and non – kinetic methods of determination of reaction mechanisms – product analysis and its importance – cross over experiment – isotopic labelling studies –stereo chemical studies.

1.4. Correlation analysis: Linear free energy relations – Hammett equation – significance of sigma (σ) and rho (ρ) – applications, deviations and limitations – Taft equation and applications.

UNIT-II **18 hours**

REAGENTS IN ORGANIC SYNTHESIS

2.1 Reducing Reagents: Reduction of CO to CH_2 in aldehydes and ketones - Wolff-Kishner reduction and Huang-Minlon modification. Metal hydride reduction - $NaCNBH_3$, $Na(OAc)_3BH$, Reduction by dissolving metals–sodium-liquid alcohol, sodium-liquid ammonia. Tin-hydrochloric acid, Zinc-hydrochloric acid, zinc-acetic acid, Magnesium-amalgam. Stannous chloride, sodium metabisulphite and Baker's Yeast.

2.2 **Oxidizing Reagents**: $K_2Cr_2O_7/SO_4$ (Jones reagent), Selenium dioxide CrO_3-pyridine (Collin's reagent), PCC (Corey's reagent), hypervalent iodine reagents (IBX, Dess-Martin periodinane), DMSO based reagents (Swern oxidation). Oxidation involving C-C bond cleavage using HIO_4, CrO_3 (cycloalkanones). Oxidation of C=C using $NaIO_4$ and OsO_4, aromatic rings using RuO_4. Oxidation of aldehydes and ketones with H_2O_2 (Dakin reaction), with per acid (Baeyer-Villiger oxidation).

UNIT–III **18 hours**

SUBSTITUTION REACTIONS

3.1. Aliphatic nucleophilic substitution:

$^{\#}SN^1$, SN^2 and SN^i mechanisms$^{\#}$ - Effect of substrate structure, leaving group, attacking nucleophiles and solvent. Neighbouring group participation - Substitution at norbornyl, bridgehead systems, allylic & vinylic carbons and substitution by ambident nucleophiles.

3.2 Aliphatic electrophilic substitution:

SE^1, SE^2 and SE^i mechanism - Reactivity. Effect of substrate, leaving group, attacking electrophiles and solvent. Keto-enol interconversion, Stark-Enamine reaction, halogenation of aldehydes and ketones and decarboxylation of aliphatic acids.

3.3 Aromatic nucleophilic and electrophilic substitutions:

Aromatic nucleophilic substitution - Unimolecular, bimolecular and benzyne mechanisms. Zeigler alkylation, Chichibabin reaction. Arenium ion mechanism. Isolation of arenium ion intermediates, isotope effects.

Aromatic electrophilic substitution - SE^1 mechanism, orientation & reactivity in mono substituted benzene rings, ortho/para ratio, ipso attack, orientation in benzene rings with more than one substituents.

UNIT–IV **18 hours**

ADDITION AND ELIMINATION REACTIONS

4.1. Addition Reactions: Addition to carbon-carbon multiple bonds – Electrophilic addition, nucleophilic and free radical additions, orientation and reactivity, Hydroxylation, Hydroboration, Epoxidation, Diels-Alder reaction. Michael addition, Ozonolysis, 1,3 – dipolar addition reaction . Stereochemical studies in addition reactions. Addition to carbonyl and conjugated carbonyl system-Mechanism – Grignard reagents – 1,2 and 1,4-additions (dimethyllithiumcuprate),Benzoin, Knovenagel, Stobbe and Darzen'sglycidic ester condensation and Reformatsky reactions.

4.2 Elimination Reaction: α-Elimination, β-elimination, E_1, E_2 and E_1CB mechanism – stereochemistry of elimination – orientation of the double bond – effect of changes in the substrate, base, leaving group and medium on E_1, E_2, E_1CB reactions. Elimination Vs Substitution – pyrolytic cis elimination – Bredt's rule-Hofmann degradation, Cope elimination -Chugaev reaction – dehydration of alcohols – dehydrohalogenation.

UNIT–V

Steroids, Carotenoids and Flavones **18 hours**

5.1 Steroids: Classification – Structural elucidation and medicinal values of cholesterol (synthesis not required), oestrone, equilenin and progesterone, stereochemistry of steroids.

5.2 Carotenoids: Classification, structural elucidation of α-carotene, β- carotene and xanthophylls.

5.3 Flavones: Structural elucidation of flavone, flavanol and isoflavone.

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	V.K. Ahulwalia & Rakesh Kumar	Organic Reaction Mechanism	3rd Edition	Narosa Publishing House	2009	I, II, III & III
2.	K.S. Mukherjee	Mechanism of Organic Chemistry	2nd Edition	Arunabha Sen., Books & Allied (P) Ltd.	2010	III
3.	Francis A. Carey Richard J. Sunberg	Advanced Organic Chemistry	5th Edition	Springer International Edition	2012	IV
4.	Gurdeep Chatwal	Organic Chemistry of Natural Poducts	Vol.I & II Revised 5th Edition	Himalaya Publishing House	2005	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher Details	Year	Units Covered
1	F.A.Carey and R.J.Sund berg	Advanced organic Chemistry	Vol I and II – 3rd Edition.	Plenum Publications.	1984	I, II, III & IV
2	S.P. Shukla and G.L Trivedi	Modern Organic Chemistry	Millinium Edition	Rajendran Printers Pvt. Ltd., New Delhi	2000	II
3	O.P. Agarwal	Reactions and Reagent in Organic Chemistry	5th Edition	Goel Publishing House ,Meerut.	2005	V
4.	J.N. Gurtu and R.Kapoor	Organic Reactions and Reagents	1st Edition	Sultan Chand Company Pvt.Ltd.	1988	II
5.	R.O.C Norman	Principles of Organic Synthesis	2nd Edition	Chapman and Hall Publications	1986	III & IV

Web Reference: https://swayam.gov.in/nd2_ugc19_ch01/preview

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
I	**20PCH1CC2**			**ORGANIC REACTION MECHANISMS, REAGENTS AND NATURAL PRODUCTS**			**6**		**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓			✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO3	✓	✓	✓			✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches = 41, Relationship : High										

Prepared by:

1. Dr. J. Sirajudeen
2. Dr. K. Riaz Ahmed

Checked by: Dr. M. Mohamed Sihabudeen

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1CC3P	Core –III	INORGANIC ESTIMATION AND COMPLEX PREPARATIONS - PRACTICAL	6	4	100	20	80

Course Outcomes (COs):

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

CO1: Apply appropriate methods of precipitation to distinguish metal ions.

CO2: Determine the concentration of analyte by precipitation technique.

CO3: Estimate the amount of metals present in the mixture.

CO4: Synthesize the metal complexes.

CO5: Perform the analysis of ores and industrial materials

List of Practicals:

I. Estimation of the following metal ions by volumetric and gravimetric/Complexometric methods: 50 Marks

1. Cu (V) Ni (G/C)
2. Cu (V) Zn (G/C)
3. Cu (V) Mg (G/C)
4. Zn (V) Cu (G/C)
5. Fe (V) Zn (G/C)

Note: V - Volumetric
G -Gravimetric
C - Complexometric

II. Complex Preparations: 25 Marks

1. Tetramminecopper(II)sulphate
2. Potassiumtrioxalatochromate(III)
3. Hexathiourealead(II)nitrate
4. Potassiumtrioxalatoaluminate(III)
5. Tristhioureacopper(I)chloride
6. Tristhioureacopper(II)sulphate

III. Viva-Voce: 05 Marks

Scheme of valuation

For Estimation:

Procedure writing -10 marks

Results:

1-2% - 40 marks
2-3% - 35 marks
3-4% - 30 marks
>4% - 20 marks

For Complex Preparation:

Quantity of crude sample – 15 marks

Quality of recrystalised samples- 10 marks

Text Books:

S.No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Vogel A I	A Text Book of Quantitative Inorganic Analysis	3rd Edition	Longman Group	1972	All
2.	Vogel A I	Text Book of Macro and Semi micro Qualitative Inorganic Analysis	5th Edition	Longman Group	1979	All

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
I	20PCH1CC3P			INORGANIC ESTIMATION AND COMPLEX PREPARATIONS - PRACTICAL			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓	✓		
CO2	✓	✓		✓		✓	✓	✓		
CO3	✓	✓		✓		✓	✓	✓		
CO4	✓	✓		✓		✓	✓			✓
CO5	✓	✓		✓	✓	✓			✓	✓
Number of Matches = 31, Relationship : Moderate										

Prepared by:

1. Dr. M. Syed Ali Padusha
2. Dr. F. M. Mashood Ahamed

Checked by:

Dr. A. Jamal Abdul Nasser

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1CC4P	Core –IV	ORGANIC PREPARATIONS AND ESTIMATION - PRACTICAL	6	4	100	20	80

Course Outcomes (COs):

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

CO1: Design a reaction procedure for the synthesis of compounds

CO2: Prepare the organic compounds and ensure the purity applying the appropriate techniques

CO3: Perform recrystallization process for organic compounds

CO4: Appraise the quantitative method for the essential organic compounds

CO5: Understand the principle and estimation techniques of organic compounds

List of Practicals:

I. Quantitative Analysis of Organic Compounds: 50 Marks

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Ethyl Methyl Ketone
4. Estimation of Glucose
5. Estimation of Ascorbic acid

II. **Two Stage Preparations: 25 Marks**

1. Acetylsalicylicacid from methylsalicylate
2. 1,3,5 – Tribromobenzene from Aniline
3. *p*-Nitroaniline from acetanilide
4. *p*-Bromoaniline from acetanilide
5. Benzilic acid from benzoin
6. Benzaldehyde to chalcone epoxide via chalcone
7. Cyclohexanone to caprolactone via cyclohexanone oxime

III. **Viva-Voce 05 Marks**

Scheme of valuation

For Estimation:

Procedure writing -10 marks

Results:

1-2% - 40 marks
2-3% - 35 marks
3-4% - 30 marks
>4% - 20 marks

For Two Stage Preparations:

Quantity of crude samples (stage I & II) =7.5+7.5=15 marks

Quality of recrystalised samples (stage I & II) = 5 + 5=10 marks

Text Books:

S.No.	Author Name	Book Name	Edition	Publisher detail	Year
1.	Vogel A I	A Text Book of Practical Organic Analysis	5th Edition	Longman Group	1989

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
I	20PCH1CC4P			ORGANIC PREPARATION AND ESTIMATIONS - PRACTICAL			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓				✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓			✓
CO3	✓		✓	✓		✓	✓	✓		✓
CO4	✓	✓		✓		✓	✓			✓
CO5	✓	✓	✓	✓		✓	✓			✓
Number of Matches = 32, Relationship : Moderate										

Prepared by:

1. Dr. A. Zahir Hussain
2. Dr. A. Asrar Ahamed

Checked by: Dr. M. Mohamed Sihabudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1DE1A	DSE –I	QUANTUM CHEMISTRY, KINETICS OF SOLUTIONS AND ELECTRODES	6	4	100	25	75

Course Outcomes (COs):

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

CO1: Apply quantum mechanics in solving SWE to single and much particle system.

CO2: Construct slaters determinant to molecules and to solve it.

CO3: Evaluate HMO theory to organic molecules.

CO4: Discuss the kinetics of solution, fast reactions and catalyzed reactions.

CO5: Compare the different theories of multiple layers and appreciate their significance.

UNIT – I **18hours**

Basic concepts of Quantum Mechanics

1.1. Classical mechanics – #General principles, basic assumptions, postulates of classical mechanics, conservation laws, Lagrange's and Hamilton's equations of Motion (no derivation)#. Functions – Definition, Implicit and explicit functions, odd and even functions, integrals of odd and even functions, set of functions, Eigen functions and Eigen values, orthogonality, normalization, orthonormal functions.

1.2. Operators - algebra of operators, commutation relations, linear, angular momentum, Laplacian, Hermitian and Hamiltonian operator, Hermitian property of operators.

1.3. Postulates of quantum mechanics – Solving the Schrodinger wave equation (SWE) to simple systems viz., particle in a box – one and three dimensional, Bohr's Correspondence principle
(Problems from functions, operators, 1D and 3D box).

UNIT – II **18 hours**

Applications of Quantum Mechanics-I

2.1 Setting and solving Schrödinger wave equation for harmonic oscillator, rigid-rotator, hydrogen and hydrogen like atoms (He^+ and Li^{2+}). Significance of n, l and m. Shapes of atomic orbitals - radial and angular probability distribution functions.

2.2 Approximation methods - linear variation principle, application to hydrogen and helium atoms, perturbation method for non-degenerate systems, application of perturbation theory to helium atom.

UNIT–III **18 hours**

Applications of Quantum Mechanics-II

3.1 Two electron systems – symmetric and anti-symmetric wave functions, spin of electrons and Pauli's principles and Slater determinant, self-consistent field theory - Hartree-Fock Self Consistent field theory, Slater type orbitals – Slater rules, orbital energies.

3.2 Theory of chemical bonding (diatomic molecules) – Born-Oppenheimer approximation, LCAO-MO and VB treatments of the hydrogen molecule, Huckel's molecular orbital (HMO) theory and its applications to ethylene, allyl radical and butadiene (linear), principle of hybridization – sp, sp^2 and sp^3.

UNIT-IV **18 hours**

Kinetics of Solutions, Catalysis and Fast reactions

4.1 Factors influencing reaction rates in solutions. Application of ARRT to solution kinetics. Effects of solvents - double sphere and single sphere model and effect of ionic strength. Influence of pressure on reaction rates in solution - significance of volume of activation.

4.2. Homogeneous catalysis: #Acid-Base catalysis – General and specific Acid-Base catalysis. Acidity function - Hammett-Deyrup acidity function, Bronsted catalytic law#. Enzyme catalysis- Michaelis-Menten law, influence of pH and temperature on enzyme catalysis.

4.3 Fast reactions: Study of kinetics by stopped flow technique, relaxation methods - T and P Jump methods, flash photolysis and magnetic resonance methods (NMR & ESR). (Problems from 4.1)

UNIT- V **18 hours**

Electro Kinetic Phenomena and Electrode Kinetics

5.1 #Debye-Huckel-Onsager theory of strong electrolytes, Debye Huckel limiting law#, activity coefficient at higher concentration - Bjerrum model. Electrical double layer potential – zeta potential, theory of multiple layers at electrode - Helmholtz, Goy-Chapmann, Stern, Devanathan models. Electro kinetic phenomena – electrophoresis, electrosmosis, streaming potential and sedimentation potential. Electro capillary phenomena – Capillary Rise method and Determination of interfacial tension.

5.2. Process at Electrode – Rate of Charge Transfer- Current Density – Butler-Volmer equation – Tafel equation.

5.3. Principles of Electro deposition of Metals. Electro chemical corrosion of Metals - Construction and use of Pourbaix and Evans diagrams. Prevention of Corrosion – Electro Chemical oxidation and Reduction.

#------ # Self study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	A. K. Chandra	Introductory Quantum Chemistry	4th Edition	Tata – McGraw Hill	2010	I, II & III
2.	R. K. Prasad	Quantum Chemistry- Through Problems and Solutions	2nd Edition	New Age Publications	1997	I, II & III
3.	J.M. Anderson	Mathematics of Quantum Chemistry	Revised Edition	Dover Publications	2005	I, II & III
4.	John O'M Bockris and A. K.N. Reddy	Modern Electrochemistry	Volume 2, Revised Edition	Anne Book House, India	2008	V
5	Laidler	Chemical Kinetics	3rd Edition	Pearson Publisher	2003	IV
6	Kuriacose and Rajaram	Kinetics and Mechanism of Chemical Transformation	2nd Edition	Mcmillan & Co	2000	IV

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	F. L. Pillar	Elementary Quantum Chemistry	2nd Edition	Dover Publications, INC. Mineola, New York	2001	I, II & III
2.	I. N. Levine	Quantum Chemistry	7th Edition	Prentice Hall OfInia, Pvt. Ltd,	2016	I, II & III
3.	James House	Fundamentals of Quantum Chemistry	2nd Edition	Academic Press	2003	I, II & III
4.	D.R. Crow	Principles and Applications of Electrochemistry	4th Edition	Chapman and Hall, London,	2004	V
5.	P. H. Rieger	Electro Chemistry	2nd Edition	Springer-Science Business media	1993	V

Web Reference: Unit-I and II; www.nptel.ac.in/courses/104108057/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits
I	20PCH1DE1A	QUANTUM CHEMISTRY, KINETICS OF SOLUTIONS AND ELECTRODES	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓	✓	✓			✓
CO2	✓	✓		✓	✓	✓	✓			✓
CO3	✓			✓	✓	✓	✓	✓		✓
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches = 39,						Relationship : High				

Prepared by:

1. Dr. A. JAFAR AHAMED
2. Dr. M. SYED ALI PADUSHA

Checked by: Dr. M. SEENI MUBARAK

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PCH1DE1B	DSE –I	QUANTUM CHEMISTRY AND SPECTROSCOPY	6	4	100	25	75

Course Outcomes (COs):

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

CO1: Apply quantum mechanics in solving SWE to single and much particle system.

CO2: Evaluate HMO theory to organic molecules.

CO3: Differentiate the principles of different spectroscopies.

CO4: Assess the principles and applications of NMRI, FT-NMR and Solid state NMR.

CO5: Compare the applications and advantages of conventional NMR and 2D-NMR

UNIT – I **18 hours**

Classical Mechanics and Quantum Mechanics

1.1. Classical mechanics – General principles, basic assumptions, postulates of classical mechanics, conservation laws, D'Alembert's principle, Lagrange's and Hamilton's equations of motion (no derivation). Operators- algebra of operators, commutation relations, commutators, linear, angular momentum, Laplacian, Hermitian, Hamiltonian and Ladder operators, eigen values and eigen functions, Hermitian property of operators, #orthogonality and normalization#.

1.2. Postulates of quantum mechanics – discussion of the Schrödinger wave equation to simple systems viz., particle in a box – one and three dimensional, quantum numbers, harmonic oscillator – zero-point energy, Bohr's Correspondence principle, rigid-rotator- rotational and vibrational quantum numbers, Hydrogen and hydrogen like atoms (He^+ and Li^{2+}), #significance of n, l and m, shapes of atomic orbitals – radial and angular probability distribution functions#.

UNIT-II **18 hours**

Application of Quantum Mechanics to Multi electronic Systems:

2.1. Approximation methods - linear variation principle, application to hydrogen and helium atoms, perturbation method for non degenerate systems, application of perturbation theory to helium atom.

2.2.Two electron systems – symmetric and antisymmetric wave functions, spin of electrons and Pauli's principles and Slater determinant, self consistent field theory - Hartrees theory, Hartree-Fock-Self-Consistent field theory, #Slater type orbitals – slater rules, orbital energies#.

2.3.Theory of chemical bonding (diatomic molecules)-Born-Oppenheimer approximation, LCAO- MO and VB treatments of the hydrogen molecule, Huckel molecular orbital (HMO) theory and its applications to conjugated systems - ethylene, allyl radical and butadiene(linear) principle of hybridization-sp, sp2 and sp3

UNIT-III **18 hours**

Theory of IR and Raman spectroscopy:

3.1. IR Spectroscopy: Einstein coefficient of absorption and transition probabilities – basics selection rules – representation of spectra – the width and intensity spectral transitions – oscillator strength. Vibration spectra – selection rules– harmonic and anharmonic oscillators – hot band, overtones – Fermi resonance, combination bands, rotation – vibration spectra of diatomic molecules – transition for the rigid rotor – coupling of rotation and vibration– linear and perpendicular bonds – FT-IR spectroscopy. #PQR – branches#.

3.2. Raman Spectroscopy: Raman Effect – elastic and inelastic scattering – selection rules – pure rotational and rotational-vibrational Raman spectra – polarization of light and Raman Effect – mutual exclusion principle –#Fermi resonance – laser Raman spectroscopy#.

UNIT-IV **18 hours**

4.1. THEORY OF NMR-I

Behavior of a bar magnet in a magnetic field – Magnetization vectors – resonance condition – relaxation process – Bloch equation – chemical shift and its measurement. Scalar Spin-Spin Coupling Mechanism – Nature of the Coupling, Direct Dipolar Coupling – NMR in Solids – magic angle spinning –#nuclear magnetic resonance imaging (NMRI) – principles and applications#.

4.2. FT-NMR – Principle, Measurements of T1 by FTS, Use of T1 for peak assignment.

UNIT – V **18 hours**

THEORY OF NMR-II

5.1. Second Order Spectra – Introduction, More Complicated Second Order System, Double Resonance and Spin Tickling Experiments - elementary idea, Spectral Simplification. Evaluation of thermodynamic data with NMR – Rate constants and activation energies from NMR – Determination of reaction orders by NMR #some application of NMR kinetic studies#.

5.2. Two dimensional NMR –Theory of 2D NMR (preliminary)

#Self study#

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	A. K. Chandra	Introductory Quantum Chemistry	4th Edition	Tata – McGraw Hill	2010	I & II
2.	R. K. Prasad	Quantum Chemistry-Through Problems and Solutions	2nd Edition	New Age Publications	1997	I & II
3.	J. M. Anderson	Mathematics of Quantum Chemistry	Revised Edition	Dover Publications	2005	I & II
4.	C. N. Banwell and E. M. Mccash,	Fundamentals of Molecular Spectroscopy	Fourth Edition (Indian Edition)	Tata McGraw-Hill Publishing Company Limited, New Delhi,	2017	III, IV & V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	F. L. Pillar	Elementary Quantum Chemistry	2nd Edition	Dover Publications, INC. Mineola, New York	2001	I & II
2.	I. N. Levine	Quantum Chemistry	7th edition	Prentice Hall OfInia, Pvt. Ltd,	2016	I & II
3.	James House	Fundamentals of Quantum Chemistry	2nd Edition	Academic Press	2003	I & II
4.	G. Aruldhas	Molecular structure and spectroscopy	2nd edition	PHI learning Pvt. Ltd., New Delhi	2016	III, IV & V
5.	David. W. Ball	Physical Chemistry	2nd Edition	Cengage Learning India Pvt. Ltd., New Delhi	2017	III, IV & V

Web Reference: Unit-I; www.nptel.ac.in/courses/104108057/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
I	20PCH1DE1B			QUANTUM CHEMISTRY AND SPECTROSCOPY			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓	✓				✓
CO2	✓	✓			✓	✓				✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches = 40, Relationship : High										

Prepared by:

1. Dr. A. JAFAR AHAMED
2. Dr. M. SYED ALI PADUSHA

Checked by: Dr. M. SEENI MUBARAK

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2CC5	Core – V	ORGANIC REACTIONS, STEREOCHEMISTRY AND NATURAL PRODUCTS	6	5	100	25	75

Course Outcome (COs):

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

CO1: Predict R, S and E, Z-notation in Organic compounds.

CO2: Categorize stereo selective and enantio selective asymmetric synthesis.

CO3: Differentiate aromatic, anti-aromatic and non-aromatic compounds.

CO4: Conclude the structure and importance of alkaloids, terpenoids, heterocyclic compounds and to appraise their medicinal properties.

CO5: Generate the mechanism for different types of novel synthetic methods.

UNIT–I **18 hours**

Stereochemistry

1.1. #Newman, Sawhorse and Fisher projection formulae and interconversion#. Concept of chirality-Enantiotopic and diastereotopic atoms and groups, prochirality, stereogeneic centre and enantiomeric excess. E-Z nomenclature. Determination of configuration of geometrical isomers.

1.2. R, S notations of acyclic and cyclic chiral compounds - allenes, spiranes and biphenyl.

1.3. Conformational Analysis: Conformation of some simple 1, 2-disubstituted ethane derivatives. Conformation of cyclic compounds 3, 4, 5 & 6 membered rings. Conformational analysis of mono and di substituted cyclohexane and cyclohexanone. Stereochemistry of cis and trans decalin.

UNIT–II **18 hours**

Asymmetric synthesis and Dynamic stereochemistry

2.1 Asymmetric Synthesis – Basic Principles – stereoselective reduction of cholestan-3-one (Diastereoselectivity), conversion of L-tyrosine into L-DOPA, nucleophilic attack on acyclic chiral carbonyl compounds (Cram's rule – the Felkin – Ahn modification, a diastereoselective synthesis, Enanatioselective aldol condensation via chiral enolates (Double asymmetric synthesis) the use of chiral reagents (Third – generation method) and chiral catalysts, asymmetric reduction using chiral trialkylboranes (enantioselective reduction of aldehydes and ketones) asymmetric reduction using lithium aluminium hydride (reduction via chiral metal hydride complexes) use of Baker's yeast.

2.2. D**ynamic stereochemistry:** Quantitative correlations between conformation and reactivity. Weinstein-Eliel equation – Curtin-Hammett principle – Conformation and reactivity of mono and di substituted cyclic systems – Saponification of ester – Esterification of an alcohol – Chromic acid oxidation of cyclohexanol – Neighbouring group participation – De-amination of 2-amino cyclohexanol – Sharpless asymmetric epoxidation – stereospecific and stereoselective reactions.

UNIT–III **18 hours**

Aromaticity

3.1. Definition of Aromaticity – Huckel's and Craig's Rules. Ring currents. Non-benzenoid aromatic compounds – Aromatic character in Three, Five, Six, Seven and Eight membered ring. Effect of aromaticity on bond lengths, resonance energies and induced ring current. Aromatic character in fused ring systems. Concept of Homo aromaticity and Hetero aromaticity.

3.2. Systems with Two, Four, Eight and Ten electron systems. Annulene. Aromaticity in Sydnones, Azulene and fullerenes. Alternant and non-alternant hydrocarbons.

UNIT–IV **18 hours**

Heterocyclic Compounds, Terpenoids and Alkaloids

4.1. Heterocyclic Compounds: Chemistry of non-aromatic heterocycles- Oxiranes, Thiranes, and Azetidines. Ring synthesis and reactions of aromatic heterocycles - Oxazoles, Thiazoles and Imidazoles,.

4.2. Terpenoids: Classification of Terpenoids - Structural elucidation and medicinal uses of α-Pinene, Camphor and Zingiberene.

4.3. Alkaloids: Classification of alkaloids- Structural elucidation and medicinal values of quinine, Papaverine and morphine.

UNIT–V **18 hours**

5.1. Name reactions: Dieckmanns, Stobbe, Darzen’s Glycidic ester condensation, Houben –Hoesch. Vilmesmier-Haack and Knoevenagal

5.2. Concerted rearrangements: Cope (including Oxy-Cope) and Claisen.

5.3. Cationic rearrangements: Demjanov, Pummerer, Schmidt and Dienone -phenol.

5.4. Anionic rearrangements: Brook, Favorski, Neber, Von Richter, Sommelet – Hauser.

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	D.Nasipuri,	Stereochemistry of organic compounds – principles and Applications	2nd Edition	New Age internationals	2002	I & II
2.	Ernest L. Eliel	Stereochemistry of Organic Compounds	1st Edition	Wiley	2010	I & II
3.	P.S. Kalsi	Stereochemistry of organic compounds	8th Edition	New Age internationals publishers private Limited	2010	I & II
4.	V.K. Ahluwalia & Rakesh K.Parashar	Organic Reaction Mechanism	4th Edition	Narosa Publication	2010	V
5.	Gurdeep Chatwal	Organic Chemistry of Natural Poducts	5th Edition	Himalaya Publishing House	2005	IV

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	Raj K. Bansal	Heterocyclic Chemistry	5th Edition	New Age International Publishers	2014	IV
2.	F.A. Carey and R.J. Sund berg	Advanced Organic Chemistry	Vol.I & II 3rd Edition	Plenum Publications.	1984	I, II, III & V
3.	S.P. Shukla and G.L Trivedi	Modern Organic Chemistry.	Millinium , 2nd Edition	Rajendran Ravidra Printers Pvt.Ltd., New Delhi	2000	II

Web Reference: https://swayam.gov.in/nd1_noc19_cy25/preview

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours		Credits
II	20PCH2CC5			ORGANIC REACTIONS, STEREOCHEMISTRY AND NATURAL PRODUCTS			6		5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓			✓
CO2	✓	✓		✓	✓	✓	✓			✓
CO3	✓	✓		✓	✓	✓	✓			✓
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO5	✓	✓		✓	✓	✓	✓		✓	✓
Number of Matches = 38, Relationship : High										

Prepared by:

1. Dr. J. Sirajudeen
2. Dr. J. Muneer Ahamath

Checked by: Dr. M. Mohamed Sihabudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2CC6	Core – VI	THEORY AND APPLICATIONS OF GROUP THEORY AND SPECTROSCOPY	6	5	100	25	75

Course outcome (COs):

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

CO1: Construct the character table for molecules of different point groups.
CO2: Appraise spectroscopic selection rules to molecules applying group theoretical concepts.
CO3: Differentiate molecular symmetry and crystallographic symmetry.
CO4: Apply the theory of IR and Raman spectroscopy.
CO5: Compare the principles and applications of NMR, NMRI and solid state NMR.

UNIT – I **18 hours**

Elements of Group Theory

1.1 Symmetry elements and symmetry operations, Group - Rules for forming a Group, Finite Group, Infinite Group, Abelian Group, Cyclic Group, Sub Groups, Group Multiplication Table- Class and Similarity transformation.

1.2 Point Group – Method of Assigning Point Group- Schoenflies symbols, derivation of Matrix form of E, C_n, σ, S_n and i. Reducible and Irreducible Representations.

1.3 The Great Orthogonality Theorem – Properties of Irreducible Representation, Construction of Character Table for C_{2v}, C_{2h} and C_{3v} point Groups – Explanation of Character Table- basic idea of correlation table.

UNIT – II **18 hours**

Applications of Group Theory -I

2.1 The direct product and its applications, applications of group theory to spectroscopy – vanishing of integrals, symmetry selection rules for vibrational, Raman and electronic spectroscopy.

2.2. Reduction Formula and its applications, determination of symmetries of vibrational modes and their IR and Raman activities in non-linear molecules (H_2O, NH_3 and BF_3) and linear molecules (CO_2 and C_2H_2) sub group and Integration method, mutual exclusion rule, electronic transitions in formaldehyde and ethylene using group theory.

UNIT – III **18 hours**

Applications of Group Theory -II

3.1 Applications of Group theory - Hybridization schemes for atoms in molecules of different geometry – tetrahedral (CH_4), triangular (BF_3) planar linear (C_2H_2) and non-linear (C_2H_4) molecules.

3.2 Symmetry in crystals - Hermann - Mauguin symbols. Space groups of crystals - Translational elements of symmetry - Comparison of crystal symmetry with molecular symmetry.

3.3 Projection Operator – Symmetry Adapted Linear Combination (SALC) procedure. Symmetry factors of secular determinant and its applications to butadiene.

UNIT – IV **18 hours**

Theory of IR and Raman Spectroscopy

4.1 **IR Spectra**- Theory of Rotational-Vibrational spectra – Harmonic and anharmonic oscillator. Calculation of force constant and effect of isotopic substitution on vibrational frequencies. Hot band, overtones, Fermi resonance, combination bands. Coupling of rotation and vibration-linear and perpendicular bands – PQR branches – (Problems - force constant)

4.2. **Raman Spectra-** #Polarization of light and Raman Effect– elastic and inelastic scattering.# Pure rotational and rotational-Vibrational Raman spectra. Lasers-special properties of laser, types of lasers. Laser Raman spectroscopy- theory and its advantages. Resonance Raman Spectroscopy, surface enhanced Raman scattering-theory and advantages.

UNIT – V **18 hours**

Theory of NMR Spectroscopy

5.1. Behavior of a bar magnet in a magnetic field – Magnetization vectors – resonance condition–relaxation process – effect of quadrupole nuclei on relaxation mechanism- Bloch equation–# chemical shift and its measurement#-

5.2. Scalar Spin - Spin Coupling Mechanism – Nature of the Coupling, Direct Dipolar Coupling –NMR in solids-Magic angle spinning- Nuclear Magnetic Resonance Imaging (NMRI) – principle and applications

5.3. FT-NMR – Principle, measurements of T1 by FTS, Use of T1 for peak assignment, Theory and advantages of 2D NMR

Self study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	K.V. Raman	Group theory and its Application to Chemistry	1st Edition	Tata-McGraw –Hill Publishing Company Limited, New Delhi	2000	I, II & III
2.	K. Veera Reddy	Symmetry and Spectroscopy of Molecules	Reprint	New Age International Publishers	2010	IV
3.	C. N. Banwell and E. M. Mccash,	Fundamentals of Molecular Spectroscopy	Fourth Edition (Indian Edition)	Tata McGraw-Hill Publishing Company Limited, New Delhi,	2017	IV & V
4.	G. M. Barrow	Introduction to Molecular Spectroscopy	Revised Edition	Tata-McGraw- Hill Edition	1993	IV & V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	F. A. Cotton,	Chemical Application of Group Theory	2nd Edition	Wiley – Eastern Press	1995	I, II & III
2.	G. Aruldhas	Molecular Structure and Spectroscopy	2nd Edition	PHI learning Pvt. Ltd., New Delhi	2016	IV
3.	Manas Chanda	Structure and Chemical Bonding including Molecular Spectra	Reprint	Tata- McGraw-Hill Publishing company Ltd., New Delhi-2.	2000	IV
5.	R. S. Drago	Physical Methods in Chemistry	Reprint	East West Press Ltd.,	1971	V

Web Reference: Unit-I, II and III; www.nptel.ac.in/courses/104104080/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**		**Hours**				**Credits**
II	**20PCH2CC6**			**THEORY AND APPLICATIONS OF GROUP THEORY AND SPECTROSCOPY**		**6**				**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓				✓				
CO2	✓	✓	✓				✓			✓
CO3	✓	✓	✓	✓		✓		✓		✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches = 35, Relationship : High										

Prepared by:

1. Dr. M. SYED ALI PADUSHA
2. Dr. M. ANWAR SATHIQ

Checked by: Dr. M. SEENI MUBARAK

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2CC7P	Core – VII	INORGANIC QUALITATIVE ANALYSIS AND COLORIMETRIC ESTIMATIONS - PRACTICAL	6	4	100	20	80

Course Outcomes (COs):

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

CO1: Analyse the elements in a mixture.

CO2: Categorize the metals based on its nature.

CO3: Spot a metal ion by carrying out a suitable reaction.

CO4: Apply the principle of photo colorimetry for metal ion estimation.

CO5: Appraise the principle of photo colorimetry in food product analysis

List of Practicals:

I. Semi-micro Qualitative Analysis: -50 Marks

Analysis of two common and two rare earth elements in a given inorganic mixture:

1. Common: Pb, Cu, Bi, Cd, Zn, Co, Ni, Ca, Ba, Sr

2. Rare: W, Se, Te, Mo, Ce, Zr, Th, V, Li

II. **Colorimetric Estimations: -25 Marks**

Cu, Fe, Mn, Ni and Cr

III. Viva-Voce: -05 Marks

Scheme of Valuation:

Procedure Writing - 10 Marks

For Analysis:

4 radicals correct with suitable tests: 40 marks
3 radicals correct with suitable tests: 30 marks
2 radicals correct with suitable tests: 20 marks
1 radical correct with suitable tests: 10 marks

For Colorimetric Estimations:

1-2% - 25 marks

2-3% - 20 marks

3-4% - 15 marks

>4% - 10 marks

Text Books:

S.No.	Author Name	Book Name	Edition	Publisher detail	Year
1.	Vogel A I	A Text Book of Quantitative Inorganic Analysis	3rd Edition	Longman Group	1972

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
II	20PCH2CC7P			INORGANIC QUALITATIVE ANALYSIS AND COLORIMETRIC ESTIMATIONS - PRACTICAL			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓			
CO2	✓	✓		✓		✓			✓	
CO3	✓	✓				✓	✓		✓	✓
CO4	✓	✓	✓			✓	✓	✓		
CO5	✓	✓		✓	✓	✓	✓		✓	✓
Number of Matches = 30, Relationship : Moderate										

Prepared by:

1. Dr. M. Syed Ali Padusha
2. Dr. F. M. Mashood Ahamed

Checked by:

Dr. A. Jamal Abdul Nasser

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2CC8P	Core – VIII	QUALITATIVE ANALYSIS OF ORGANIC MIXTURE AND CHROMATOGRAPHY TECHNIQUES - PRACTICAL	6	4	100	20	80

Course Outcomes (COs):

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

CO1: Apply pilot separation technique to the organic compounds based on the solubility

CO2: Examine the components present in the given organic mixture

CO3: Identify the functional group present in the components

CO4: Understand the concept of TLC techniques and record the R_f value of given amino acids

CO5: Apply thin layer chromatography techniques for the separation of amino acids

List of Practicals:

I. Identification of components in a two component mixture: -55 marks

Separate the following types of mixture: (a) soluble & insoluble, (b) acidic & neutral, (c) less acidic and neutral and (d) basic & neutral (both Pilot and Bulk) and analyze any one of the components present as instructed by the Teacher / Examiner. The components to be reported are:

1. Pilot separation
2. Special elements present/absent
3. Aromatic/aliphatic
4. Saturated/unsaturated
5. Functional group present
6. Suitable solid derivative

II. Chromatographic Technique: -20 marks

Separation of amino acids mixture by Thin Layer Chromatography

III. Viva-voce: -05 marks

Scheme of Valuation:

Organic Analysis	-	55 marks

Organic Analysis:

Procedure Writing	-	10 marks
Pilot separation	-	10 marks
Special elements present / absent	-	07 marks
Aromatic/ aliphatic	-	07 marks
Saturated/ unsaturated	-	07 marks
Functional group present	-	07 marks
Derivative	-	07 marks
Chromatographic Technique	-	**20 Marks**

Text Books:

S.No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Vogel A I	A Text Book of Practical Organic Analysis	5th Edition	Longman Group	1989	All

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits
II	20PCH2CC8P	QUALITATIVE ANALYSIS OF ORGANIC MIXTURE AND CHROMATOGRAPHY TECHNIQUES - PRACTICAL	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓			✓
CO2	✓	✓				✓	✓	✓		
CO3	✓	✓			✓	✓	✓	✓		
CO4	✓	✓		✓		✓	✓	✓		✓
CO5	✓	✓		✓	✓	✓	✓			✓
Number of Matches = 31, Relationship : Moderate										

Prepared by:

1. Dr. A. Zahir Hussain
2. Dr. A. Asrar Ahamed

Checked by: Dr. M. Mohamed Sihabudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2DE2A	DSE – II	CHEMISTRY OF COMPLEXES AND ORGANOMETALLICS, IR, ELECTRONIC AND MOSSBAUER SPECTROSCOPY	6	4	100	25	75

Course Outcomes (COs):

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

CO1: Examine the stability of complexes and to apply various reactions of coordination compounds in their research.

CO2: Design the synthesis, structure and bonding of carbon π–acceptor and donor complexes.

CO3: Apply the different type of organometallic reactions to explain different catalytic reactions.

CO4: Sketch the electronic transition in various d^n-systems.

CO5: Apply various spectroscopic principles to characterize inorganic and organometallic compounds

UNIT-I **18 hours**

1.1. Reactivity of Complexes in solutions – Labile and inert complexes. Ligand displacement reactions – hydrolysis, acid, base and aquation in O_h complexes. Electron Transfer Reactions - complementary and non-complementary, inner and outer sphere processes. Isomerism in square planar complexes. Trans effect – Theories and its applications. Template effect.

1.2. Stability of coordination compounds: Detection of complex formation in solution-stability constants, stepwise, overall formation constants, determination by pH-metric, polarographic and photometric methods. Factors affecting stability - statistical and chelate effects.

UNIT– II **18 hours**

Complexes of π acceptor and donor ligands

2.1. Carbonyls - $18e^-$ rule, applications of $18e^-$ rule to structural study of poly nuclear carbonyls, carbonylate anions, carbonyl hydrides, isolobal fragments. Nitrosyl complexes – Preparation and structure of bridging and terminal nitrosyls, bent and linear nitrosyls. Dinitrogen and dioxygen complexes.

2.2. Carbon π-donor Complexes: Synthesis, structure and bonding of alkene (Zeise's salt), alkyne and allyl complexes. Metallocenes- Ferrocene, preparation, properties and structure (Molecular orbital concept).

UNIT– III **18 hours**

3.1. Organometallic Chemistry: Ligand association and dissociation – oxidative addition and reductive elimination – insertion reactions – Catalysis by Organometallics - Hydrogenation, hydroformylation, polymerisation of alkenes, olefin oxidation (Wacker Process), Fischer–Tropsch synthesis, epoxidation, metathesis.

3.2. Metallobiomolecules: Hemoglobin and myoglobin – Structure and functions (oxygen transport and storage). Electron transfer and oxygen activation - Ferredoxins and rubredoxins, copper proteins - oxidases and reductases, cytochrome oxidase, superoxide dismutase. #Urease and hydrogenases – structure and functions#.

UNIT– IV **18 hours**

4.1. Electronic spectroscopy: Electronic configuration - Terms, states and microstates of atoms and ions – Derivation of term symbols d^n and arranging the various term according to their energies - spectroscopic terms – L-S coupling and jj coupling – # Racah parameters B and C – selection rules and the breakdown of selection rules – mixing of orbitals#.

4.2. Orgel diagram – characteristics, prediction and assignment of transitions for d^n weak field systems, band intensity, band width, band shape, calculation of β and 10 Dq for simple octahedral complexes of Co and Ni. Tanabe-Sugano diagrams – prediction and assignment of transitions for weak field and strong field of d^n systems. Charge transfer spectra - LMCT and MLCT.

UNIT– V **18 hours**

5.1. IR and Raman spectroscopy: Combined uses of IR and Raman spectroscopy in the structural elucidation of N_2O, H_2O, ClF_3, NO_3^- and ClO_3^-. Effect of coordination on ligand vibrations. Uses of group vibrations in the structural elucidation of metal complexes of urea, cyanide, nitrate and sulphate. Effect of isotopic substitution on vibrational spectra of metal carbonyls.

5.2. Mossbauer Spectroscopy: Mossbauer transition and Doppler Effect - isomer Shift, quadrupole effect – application to iron and tin compounds.

5.3. Lanthanides and Actinides: Co-ordination compounds of lanthanides and actinides, spectral and magnetic properties. #synthesis of transuranic elements#.

 # --------# Self study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	R. Gopalan, V. Ramalingam	Concise Coordination Chemistry	Revised 1st edition	Vikas Publishing House Pvt. Ltd., Newdelhi	2008	I & IV
2	B.D.Gupta, A.J.Elias	Basic Organometallic Chemistry-Concepts, Syntheses and Applications	Reprint	University Press, Hyderabad	2011	II & III
3	R.C.Mehrotra, A.Singh	Organometallic Chemistry-A Unified Approach	Revised 2nd Edition	New Age International Publishers	2011	II & III
4.	Satya Prakash, G.D.Tuli, S.K.Basu, R.D.Madan,	Advanced Inorganic Chemistry Vol-I	19th Edition	S.Chand & Co., Ltd., New Delhi.	2011	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Cotton and Wilkinson	Advanced Inorganic Chemistry	6th Edition	John Wiley & Sons, New York	2004	I
2.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter	Inorganic Chemistry Principles of Structure and Reactivity	4th Edition	Pearson Education, 11th Impression	2011	I, II, III, IV & V
3.	R.H. Crabtree	The Organometallic Chemistry of the Transition Metals:	6th Edition	John Wiley & Sons, New York	2000	II & III
4.	W. Kaim and B. Schewederski	Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life:	2nd Edition	John Wiley & Sons, New York, USA	2001	III
5.	P. Powell	Principles of Organometallic Chemistry	2nd Edition	Chapman and Hall, London	2003	II & III

Web Reference: https://nptel.ac.in/content/syllabus_pdf/104101121.pdf

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits
II	**20PCH2DE2A**	**CHEMISTRY OF COMPLEXES AND ORGANOMETALLICS, IR, ELECTRONIC AND MOSSBAUER SPECTROSCOPY**	**6**	**4**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓		✓	✓
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches = 46, Relationship : High										

Prepared by:

1. Dr. K. Loganathan
2. Dr. N. Mujafarkani

Checked by: Dr. A. Jamal Abdul Nasser

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PCH2DE2B	DSE – II	SPECTROSCOPY OF INORGANIC COMPLEXES AND ORGANOMETALLICS	6	4	100	25	75

Course Outcomes (COs):

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

CO1: Sketch the electronic transition in various d^n-systems

CO2: Apply various spectroscopic principles to characterize inorganic and organometallic compounds

CO3: Design various processes in extraction of metals and manufacture of alloys.

CO4: Examine the stability of complexes and to apply various reactions of coordination compounds in research.

CO5: Apply the different type of organometallic reactions to explain different catalytic reactions.

UNIT–I **18 hours**

1.1 **Electronic spectroscopy:** Electronic configuration - Terms, states and microstates of atoms and ions – Derivation term symbols (p^2 and d^2) and arranging the various term according to their energies spectroscopic terms – L-S coupling and JJ coupling – #effect of interelectronic repulsion and spin-orbit coupling# – Racah parameters B and C – selection rules and the breakdown of selection rules – mixing of orbitals.

1.2 Orgel diagram – characteristics – prediction and assignment of transitions for dn weak field systems. Tanabe – Sugano diagrams – prediction and assignment of transitions for weak field and strong field – d^n systems band intensity, band widths- band shapes- calculation of β and 10 Dq for simple octahedral complexes of Co and Ni- charge transfer spectra.

UNIT– II **18 hours**

2.1 **IR and Raman spectroscopy:** Combined use of IR and Raman spectroscopy in the structural elucidation of N_2O, H_2O, ClF_3, NO_3^-, ClO^- - Effect of coordination on ligand vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, cyanide, nitrate and sulphate – #Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal complexes#.

2.2 **Mossbauer Spectroscopy:** Mossbauer transition and Doppler Effect – isomer shift quadrupole effect – magnetic effect on spectra – simple application to iron and tin compounds.

2.3 **Lanthanides and Actinides:** co-ordination compounds of lanthanides- spectral and magnetic properties of Lanthanides and Actinides, synthesis of transuranic elements

UNIT– III **18 hours**

3.1 **Extraction and Uses of Metals:** Metallurgy of Zr, Ge, Th and U –#uses of their important compounds.#

3.2 **Alloys and Intermetallic Compounds –** Effect of alloying – types of alloys – simple mixtures – solid solutions – substitutional alloys – Industrial alloys – Substitutional alloys - Intermetallic Compounds – Hume – Rotherys rules – ferrous alloys , non- ferrous alloys – Al, Mg alloys, amalgams, alloy steels.

3.3 **Inorganic Polymers and Rings:** Phosphorus based network polymers, Coordination Polymers (Structure and properties). Preparation and Structure of Borazines & Phosphazenes Craigg and Paddock model - Dewar model – Preparation and Structure of sulphur-nitrogen ring system (S_4N_4, $N_4S_4F_4$)

UNIT– IV **18 hours**

4.1 **Reactivity of Complexes** – Kinetics and Mechanisms of reactions in solutions: Labile and inert complexes – Ligand displacement Reactions – hydrolysis – acid & base, aquation in O_h complexes. Electron Transfer Reactions, complementary and non-complementary types – inner and outer sphere processes – Isomerism in square planar complexes – Trans effect – Theories and Applications. Template effect and synthesis of macrocyclic ligands.

4.2 **Stability of coordination compounds:** Detection of complex formation in solution, stability constants, stepwise and overall formation constants pH metric, #polarographic and photometric methods of determining formation constants# - factors affecting stability – statistical and chelate effects.

UNIT– V **18 hours**

5.1 **Organometallic Chemistry:** 16 and 18 electron rule - Catalysis by Organometallics- Ligand association and dissociation – oxidative addition and reductive elimination – insertion reactions – reactions of coordinated ligands in organometallics – Hydrogenation, hydroformylation, polymerisation of alkenes, olefin oxidation (Wacker Process), Fischer–Tropsch synthesis, epoxidation, metathesis.

5.2 **Oxygen Transport and energy transfer of metals proteins:** # Hemoglobin and myoglobin – Oxygen transport and storage#. Electron transfer and Oxygen activation. Ferredoxins and rubredoxines – Copper proteins – classification – Electron transfer, oxygen transport. Oxidases and reductases – cytochrome oxidase – superoxide dismutase (Cu, Zn), Urease and hydrogenases.

Self study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	R. Gopalan and V. Ramalingam	Concise Coordination Chemistry	1st Edition	Vikas Publishing House Pvt. Ltd., New Delhi	2001	II, III & IV
2	B.D. Gupta and A.J. Elias	Basic Organometallic Chemistry-Concepts, Syntheses and Applications	1st Edition	University Press, Hyderabad	2010	V
3	R.C.Mehrotra and A.Singh	Organometallic Chemistry-A Unified Approach"	Revised 2nd Edition	New Age International Publishers	2011	V
4.	G D Tuli, S K Basu, Satya Prakash and R D Madan	Advanced Inorganic Chemistry Vol-I	19th Edition	S. Chand & Co., Ltd., New Delhi	2016	I, II & III
5.	Wolfgang Kaim, Brigitte Schwederski and Axel Klein	Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life: An Introduction and Guide	2nd Edition	John Wiley & Sons,	2013	V

BOOKS FOR REFERENCES:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter	Inorganic Chemistry Principles of Structure and Reactivity	4th Edition	Pearson Education	2009	I, II, III, IV & V
2.	Cotton and Wilkinson	Advanced Inorganic Chemistry	6th Edition	John Wiley & Sons, New York	2004	III & IV
3.	Gurdeep Raj	Advanced Inorganic Chemistry-Vol.-I	32nd Edition	Krishna's Educational Publishers	2014	III
4.	R.H. Crabtree	The Organometallic Chemistry of the Transition Metals	6th Edition	John Wiley & Sons, New York	2000	V
5.	E.A.V. Ebsworth, W.H. Rankin, Cradock	Structural Methods in Inorganic Chemistry	2nd Edition	ELBS	1988	I

Web Reference: https://nptel.ac.in/content/syllabus_pdf/104101121.pdf

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
II	20PCH2DE2B			SPECTROSCOPY OF INORGANIC COMPLEXES AND ORGANOMETALLICS			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓
Number of Matches = 40, Relationship : High										

Prepared by:

1.Dr. K. Loganathan

2.Dr. N. Mujafarkani

Checked by: Dr. A. Jamal Abdul Nasser

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
III	20PCH3CC9	Core-IX	SOLID STATE, NMR, ESR, PHOTOELECTRON SPECTROSCOPY AND BIO-MEDICINAL CHEMISTRY	6	5	100	25	75

Course Outcomes (COs):

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

1. Examine the structure of inorganic compounds by NMR and photoelectron spectroscopy.
2. Apply ESR spectroscopy to investigate the inorganic materials.
3. Explain crystal structure of the solids by X-ray, neutron and electron diffraction studies.
4. Understand the role of metal ions in biological functions.
5. Describe the drugs for detoxification, chemotherapy and radiopharmaceuticals.

UNIT-I **18 hours**

NMR and PES

1.1 NMR Spectroscopy: Principle, Larmour precession, #**splitting of nuclear magnetic energy levels, relaxation process, Chemical shift, spin - spin coupling**#, coupling constant - one bond coupling, two bond coupling, long range coupling; ^{1}H NMR spectra - SiH_3SiCl_2H, $GeClH_2GeClH_2$, PF_2H, SiH_3PH_2, BH_4^-, HD, $HRh(CN)_5^{3-}$; ^{13}C- NMR spectra- Difference between ^{1}H and ^{13}C-NMR; ^{31}P NMR – PH_3, HPF_2, H_3PO_2, H_3PO_3, H_3PO_4, P_4S_3, $HP_2O_5^{3-}$, $Rh(PPh_3)_3Cl_3$; ^{19}F NMR - ClF_3, ClF_5, TiF_4, BrF_5, PF_5. Effect of quadrupolar nuclei on the NMR spectrum, NMR of paramagnetic molecules - isotopic shifts, contact and pseudocontact shifts, Lanthanide shift reagents, fluxional behaviour of molecules in NMR.

1.2 Photoelectron spectroscopy: Principle, types - UPES, XPES. Koopman's theorem, PES of H_2, N_2 and HCl. Auger electron spectroscopy- Auger effect, applications of PES.

UNIT-II **18 hours**

ESR, Magnetism and Photochemistry of Complexes

2.1 ESR Spectroscopy: Principle, presentation of spectrum, hyperfine coupling, isotropic and anisotropic hyperfine coupling constants, Mc-Connell equation-calculation of unpaired electron density. g value in esr spectroscopy – g values of transition metal ions – dependence of spin-orbit coupling and crystal field effects; zero field splitting and Kramer's degeneracy, EPR spectra of transition metal complexes - d^1 (VO^{2+}, Ti^{3+}), d^3(Cr^{3+}) d^5 (Mn^{2+}, Fe^{3+}), d^7(Co^{2+}), d^9 (Cu^{2+})-bis(salicylaldiminecopper(II)).

2.2 Magnetic properties: Origin of magnetism - orbital magnetic moment, spin magnetic moment - #**Types of magnetism - dia, para, ferro**# ferri, and antiferro magnetism, hysteresis - magnetic properties of free ions - first and second order Zeeman effects.

2.3 Photochemistry of coordination compounds: Introduction- Photo redox reactions – inner sphere mechanism, outer sphere mechanism and decomposition. Photoisomerisation- geometrical, optical, racemisation reaction; Photo substitution reactions.

UNIT – III **18 hours**

Solid State

3.1 Crystalline solids: Unit cell, crystal symmetry, symmetry elements, crystal systems, Bravais lattices, space group, Difference between point group and space group, translational elements of symmetry- screw axis, glide plane. equivalent positions, relationship between molecular symmetry and crystallographic symmetry, reciprocal lattice- construction and advantages.

3.2 Crystal Growth methods: Conditions for growing crystal, Classification of Crystal growth methods- growth from melt - Bridgmann method, pulling method; growth from solution - **#Hydrothermal growth, Gel growth methods#**

3.3 Diffraction study: X-ray diffraction by single crystal – rotating crystal, powdered diffraction. Neutron diffraction study - Elementary treatment, comparison with X-ray diffraction. Electron diffraction- Principle and applications.

UNIT – IV **18 hours**

Bioinorganic Chemistry and Metal clusters

4.1 Metals at the centre of photosynthesis: Primary processes in photosynthesis- Photosystems - I and II – Light absorption (Energy Acquisition)-Exciton transport (Direct Energy Transfer) - **#Charge separation and electron transport - Manganese catalysed oxidation of water to molecular oxygen#.**

4.2 Biological Functions of alkali and alkaline-earth metals: Macro cycles, K^+, Na^+, Ca^{2+} and Mg^{2+} complexes with Crown ethers, Cryptands and Spherands. Ion Channels- ionophores and ion transporters, Na^+ - K^+ Pump. Catalysis and regulation of bioenergetic processes by Mg^{2+} and Ca^{2+}.

4.3 Metal Clusters and Polyacids: Metal cluster- definition, classification- preparation, properties, structure and bonding of $Re_2Cl_8^{2-}$. Polyacids – iso and heteropolyacids of Mo and W – Structure, Keggin's theory.

UNIT - V **18 hours**

Medicinal Bioinorganic Chemistry and Chemotherapy

5.1 Bioinorganic Chemistry of quintessentially toxic metals: Toxicity of Lead, Cadmium, Mercury, Chromium, Copper, Iron and Aluminium. Detoxification by metal chelation – mode of action and structure of Penicillamine, Dimercaprol, Dimercapto succinic acid, Calcium disodium edetate and Desferrioxamine.

5.2 Chemotherapy- Platinum complexes in cancer therapy- Synthesis, properties, structure, mode of action, applications, advantages and side effects of Cis-platin. Non platinum anticancer drugs, Antirheumatic agents - Gold compounds and their mode of action. Pschycopharmocological drugs -Lithium carbonate.

5.3 Radiopharmaceuticals: Technetium, Iodine, Cobalt, **#Radium and Sodium#** in radiotherapy.

 # ..... # Self-study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	E.A.V. Ebsworth, W. H. Rankin, S. Cradock	Structural Methods in Inorganic Chemistry	2nd Edition	ELBS	1987	I and II
2.	A. Abdul Jameel	Application of Physical Methods to Inorganic Compounds	1st Edition	Jan Publications, Tiruchirappalli	2007	I, II and III
3.	H. Kaur	Spectroscopy	3rd Edition	Pragati Prakasan Publications, Meerut	2006	I and II
4.	James E. Huheey, Ellen A. Keiter, Richard L. Keiter and Okhil K. Medhi	Inorganic Chemistry: Principles of Structure and Reactivity	4th Edition	Pearson Education House	2011	IV and V

5.	Stephen J. Lippard and Jeremy M. Berg	Principles of Bioinorganic Chemistry	1st Edition	University Science Books, Millvelley, California.	1994	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	P. K. Ghosh	Introduction to Photoelectron Spectroscopy	-	John Wiley, New York, USA	1989	I
2	R.S. Drago	Physical Methods in Inorganic Chemistry	1st Edition	Reinhold Publishing Corporation, New York	1977	I and II
3	Anthony P. West	Solid state Chemistry and its applications	2nd Edition	John Wiley, New York	2014	III
4	W.Kaim and B.Schwederski	Bioinorganic Chemistry: Inorganic Elements in the chemistry of life-An Introduction and Guide	2nd Edition	John Wiley & Sons, New York, USA	2013	IV and V
5	J. P. Glusker and K. N. Trueblood	Crystal Structure Analysis: A Primer	3rd Edition	Oxford University Press, UK	2010	III

Web Reference:

1. https://nptel.ac.in/courses/104/101/104101121/
2. https://nptel.ac.in/courses/104/101/104101093/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
III	**20PCH3CC9**	**SOLID STATE, NMR, ESR, PHOTOELECTRON SPECTROSCOPY AND BIO-**	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 47 , Relationship: Very High										

Prepared by:
Dr. K. Loganathan
Dr. M. Anwar Sathiq

Checked by:
Dr. A. Jamal Abdul Nasser

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
III	20PCH3CC10	CORE- X	ORGANIC SPECTROSCOPY AND NATURAL PRODUCTS	6	5	100	25	75

Course Outcomes (COs):

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

1. Analyse the nature of organic compounds based on the Electronic and vibrational transitions.
2. Predict the Chemical environment of the protons of organic compounds based on its chemical shift values.
3. Analyse the stereo chemical orientation of molecules using correlation spectroscopy.
4. Solve the molecular structure of organic compounds by combined spectral data.
5. Elucidate the structure of natural products by systematic chemical approach.

UNIT – I **18 hours**

1.1 **Ultraviolet and Visible Spectroscopy: #Basic principles of electronic transitions - correlation of energy change with electronic transitions, designation of UV bands, factors affecting Absoption bands. Applications of UV – Visible spectroscopy#** - Woodward - Fieser - Scott rules - Applications to conjugated dienes, trienes, polyenes, unsaturated carbonyl compounds, conjugated cyclic ketones and acetophenones - benzene and its substituted derivatives, Stereochemical factors affecting electronic spectra of biphenyl and binaphthyl, cis and trans isomers – angular distortion and cross conjugation, charge transfer spectra.

1.2 **Infrared Spectroscopy:** Basic principle, types of vibrations - Fermi resonance. Finger print region, factors affecting IR frequency - characteristics group frequencies, presentation and interpretation of IR spectrum, – hydrogen bonding (intermolecular and intramolecular) - conformational aspects in cyclic 1,2- diols and 1,3- diols, trans annular interaction in UV and IR - Determination of reaction rates and mechanisms of reactions employing IR and UV spectroscopy (basic aspects).

UNIT – II **18 hours**

Proton NMR Spectroscopy

2.1 Theory of NMR- Chemical and magnetic equivalence, non-equivalence , chemical shift - internal standard and solvents used - factors influencing chemical shift values –spin-spin splitting, restricted rotation around C-N, Pascal's triangle, coupling constant - dependence of J on dihedral angle, vicinal and geminal coupling, Karplus curve and equation, Long range coupling.

2.2 First order and non-first order spectra, - simplification of complex spectra - double resonance technique, high field strength and lanthanide shift reagents. Chemical spin decoupling of rapid exchangeable protons (OH, SH, COOH, NH_2) **#Variable temperature spectra#**. Nuclear Overhauser Effect (NOE).

2.3 Theory of Continuous wave (CW) NMR and Fourier Transform (FT) NMR. NMR spectrum of n-propanol, benzaldehyde, *p*-nitrobenzaldehyde, aniline, *p*-toluidine, *m*-cresol and phenyacetylene molecules. Magnetic Resonance Imaging(MRI-scan)

UNIT – III **18 hours**

^{13}C NMR 2D NMR and ESR Spectroscopy

3.1. Principle, comparison of ^{13}C- NMR and ^{1}H NMR, Chemical shift, simplification of ^{13}C- NMR - broad band decoupling and off-resonance decoupling. α, β and γ - effect of substituents (Straight and branched chain alkanes) and effect of hybridization. Calculation of chemical shifts for simple aliphatic and aromatic compounds.), DEPT spectra.

3.2. Principle of 2D NMR, COSY, NOSEY and **#ROSY#.** COSY (H-H and H-C)spectrum of Nitrotoluene and 1,3-dinitrobenzene.

3.3**.** Electron spin resonance spectroscopy: Basic principle - comparison between ESR and NMR

spectra, hyperfine splitting - factors affecting the magnitude of g values. Applications to $^{\bullet}CH_3$, $^{\bullet}CH_2D$, $^{\bullet}CD_3$, benzene, naphthalene and benzoquinone anion radicals.

UNIT – IV **18 hours**

4.1 **Mass Spectroscopy: #Basic principle, parent ion peak, base peak, isotopic peak, metastable peak and its importance#**, modes of ionization – EI, CI, FAB and ESI, recognition of molecular ion peak and isotopic peak - determination of molecular formula - nitrogen rule – DBE. Fragmentation pattern for compounds containing CH_3, OH, CHO, COOH and NH_2, Mc Lafferty rearrangement.

4.2 **Optical rotatory dispersion and circular dichroism:** Theory and terminology. Cotton effects and ORD curves, Axial haloketone rule and octant rule- applications

4.3 **Combined spectral problem** of organic compounds (UV, IR, ^{1}H, ^{13}C NMR and Mass).

UNIT – V **18 hours**

5.1 **Steroids:** Classification – Structural elucidation and medicinal values of cholesterol, oestrone, progesterone, ergosterol (synthesis not required) - Structure and importances of stigmasterol, Androsterone and equilenin.Stereochemistry of steroids.

5.2 **Carotenoids:** Introduction – Classification, structural elucidation of α- and β- carotene, xanthophylls and cyanin.

5.3 **Lipids**: **#Classification#** and biological importance of fatty acids and lipids

 # ..... # Self-study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Y.R. Sharma	Elementary Organic Spectroscopy: Principles and Chemical Applications,	1st Edition	S.Chand Publications, New Delhi	2012	I,II,III,IV
2.	Robert M. Silverstein, Francis X. Webster	Spectrometric identification of Organic compounds	6th Edition	John Wiley & Sons, India	2009	I,II,III,IV
3.	P.S.Kalsi	Spectroscopy of Organic Compounds	6th Edition	New Age international Publishers, India	2004	I,II,III,IV
4.	Q.N. Porter and J.Baldas	Mass Spectrometry of Heterocylic compounds	1st Edition	John Wiley & Sons, New Delhi	1971	IV
5.	I.L. Finar	Organic Chemistry, Vol. II	5th Edition	ELBS	1975	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	Willam Kemp	Organic Spectroscopy	3rd Edition	Macmillan, New York	1991	I,II,III,IV
2	J.R. Dyer	Application of Absorption spectroscopy of organic compounds	1st Edition	Prentice Hall, US	1965	I,II,
3	Dudley H. Williams, Ian Fleming	Spectroscopic Methods In Organic Chemistry	6th Edition	McGraw-Hill-Education-Europe	2011	I,II,III,IV
4.	Jag Mohan	Organic Spectroscopy: Principles and Applications	2nd Edition	Alpha Sciences International Ltd, India	2002	I,II,III,IV
5.	Grudeep Chatwal	Organic Chemistry of Natural Products Vol.II	3rd Edition Reprint	Himalaya Publishing House, India	2000	V

Web Reference:

1. https://www.coursera.org/lecture/spectroscopy/transitions-relevant-to-uv-vis-spectroscopy-LuyUZ
2. https://docplayer.net/21391803-Organic-spectroscopy.html
3. https://nptel.ac.in/content/storage2/courses/115101003/downloads/module2/lecture23.pdf
4. https://www.coursera.org/lecture/experimental-methods/lecture-2-basics-of-mass-spectrometry-2-AdyMm

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
III	**20PCH3CC10**	**ORGANIC SPECTROSCOPY AND NATURAL PRODUCTS**	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO3	✓	✓		✓	✓	✓	✓	✓		✓
CO4	✓		✓		✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓		✓	✓
Number of matches (✓) = 42 , Relationship: High										

Prepared by:
1. Dr. J. Sirajudeen
2. Dr. M. Purushothaman

Checked by:
Dr. M. Mohamed Sihabudeen

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PCH3CC11	Core – XI	INDUSTRIAL CHEMISTRY	6	4	100	25	75

Course Outcomes (COs):

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

1. Explain the processes involved in manufacturing of sugar, pulp and their byproducts.
2. Differentiate the ingredients of paints and varnishes.
3. Describe the manufacturing and properties of glass and cement.
4. Appreciate the properties and uses of adhesives, lubricants and explosives.
5. Appraise the quality of oils, fats and soaps.

UNIT – I **18 hours**

Sugar and paper

1.1. Sugar and Starch: Raw and refined sugar, byproducts of sugar -cane tops, bagasse, filter muds and molasses**,** starch and starch derivatives.

1.2. Fermentation: Introduction, Favorable conditions for fermentation- enzymes for fermentation and characteristics - Manufacture and uses of beer, spirit, wine, vinegar, power alcohol and ethyl alcohol.

1.3. Paper: Introduction – pulp - types - sulphate - craft pulp, soda pulp - rag pulp. manufacture of pulp - beating, refining, filling, sizing and colouring, calendaring – Manufacture of paper, quality improvement and uses of paper.

UNIT – II **18 hours**

Pigments and Surface coating Materials

2.1. Pigments **–** Definition, White pigments- white lead, zinc oxide, lithopone and TiO_2 - composition, characteristics, manufacture and uses. Bluepigments–ultra marine- characteristics and uses. Red pigments - red lead, Green pigments - chrome green, guigwet's green, black pigments and yellow pigments.

2.2. Paints - Definition – requisites of a good paint, constituents and functions, manufacture of paints, methods of applications of paints, special paints – heat and fire resistance, temperature indicating, luminous, water repellent paints - antifouling paints.

2.3. Varnishes – Definition – constituents - characteristics of a good varnish – manufacture and uses. **#Differences between paints, emulsions and varnishes#**.

UNIT – III **18 hours**

Glass, Cement and Fertilizers:

3.1. Glass–properties – types- manufacture and uses. ceramics – manufacture, properties, classification–constituents–applications.

3.2. Lime – classification- properties and manufacture. cement- manufacture of Portland cement – properties of cement – special cement- high alumina cement, water proof cement, slag cement, acid resisting cement, white cement, coloured cement and Pozzolana cement – uses.

3.3. Fertilizers – Classification, Nitrogenous fertilizers, Phosphate fertilizers and Potash fertilizers. **#harmful effects of fertilizers#**.

UNIT – IV **18 hours**

Adhesive, Lubricants and explosives

4.1. Adhesives- definition, classification - preparation and uses of animal glue, starch adhesives, rubber based adhesive, protein adhesives and synthetic resin adhesives.

4.2. Lubricants – Definition – functions - classification - synthetic lubricants – solid- semi solid and emulsion – Properties – viscosity – flash and fire point – cloud and pour point- aniline point – **#carbon residue test- selection of lubricants#.**

4.3. Explosives- Introduction, Classification, characteristics – preparation, properties and uses of Nitro cellulose, DNB, TNB, TNT, Cyclonite, Picric acid, Gun Powder, Cordite and Dynamite.

UNIT – V **18 hours**

Oils, Fats, Soap and Detergents

5.1. Oils and fats – Definition – differences between oils and fats. Types of oil, Extraction of oil from seeds, Vegetable oils – Manufacture of cotton seed oil and soybean oil – Refining of crude vegetable oils - coconut oil - palm oil - peanut oil - olive oil - **#castor oil and sunflower oil#.**

5.2. Oil purification, Hydrogenation of oil. Saponification value, Iodine value, Acid value and RM value - definition and determination.

5.3. Soap, Detergents and their composition. Manufacture of transparent and toilet soap (Hot and Cold process) – cleansing action of soaps. Waxes–classification, properties and manufacture of candles.

#_____# Self study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	B.N.Charabarthy	Industrial Chemistry	1st Edition	Oxford and IBH Publishing, NewDelhi	1999	I -V
2.	B.K.Sharma	Industrial Chemistry	1st Edition	Goel Publication, Meerut	1983	I-V

REFERENCES:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Krishnamoorthy, P. Vallinayagan and K. Jaya Subramanian	Applied Chemistry	2nd Edition	Tata McGraw-Hill Publishing Co. Ltd., New Delhi.	2001	I-V
2.	R. N. Shreve, and J. A. Brink	Chemical Process Industries	4th Edition	McGraw Hill, Toronto	1977	I-V
3	B.K. Sharma	Industrial Chemistry	1st Edition	GOEL Publishing House	1991	I-V

Web References

1. https://www.classcentral.com/course/swayam-chemical-process-safety-13942
2. https://swayam.gov.in/nd1_noc19_ce20/preview
3. https://swayam.gov.in/nd1_noc20_mm06/preview

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
III	20PCH3CC11	INDUSTRIAL CHEMISTRY	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓		✓	✓	✓	✓
CO2		✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓	✓
CO5		✓	✓	✓	✓		✓	✓	✓	✓
Number of matches (✓) = 41, Relationship: High										

Prepared by:
1. Dr. S.S. Syed Abuthahir
2. Dr. H. Mohamed Kassim Sheit

Checked by:
Dr. A. Zahir Hussain

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
III	20PCH3CC12P	Core – XII	PHYSICAL CHEMISTRY NON- ELECTRICAL - PRACTICAL	6	4	100	20	80

Course Outcomes (COs):

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

1. Construct and explain phase diagram for multi-component system
2. Investigate the mechanism of kinetics of reaction
3. Determine molecular weight using Rast's macro method
4. Explain the concept of adsorption isotherm
5. Evaluate the concept of energy of activation and Arrhenius law

List of Practicals:

I. **NON- ELECTRICAL PRACTICALS** **-75 marks**

1. Phase diagram of a binary system (Eutectic formation)
2. Phase diagram of a two-component system forming compound with congruent melting point).
3. Phase diagram of a three component liquid system (with one partially Miscible pair) (CH_2Cl_2/$CHCl_3$/Toluene/Water-Acetic acid).
4. Heat of solution of benzoic acid in water.
5. Comparison of strengths of three acids from kinetic study (Iodination of acetone)
6. Rast macro method of determining kf and molecular weight.
7. Determination of E_a and A (for the hydrolysis of ethyl acetate at different temperatures)
8. Primary salt effect (on the kinetics of reaction between $S_2O_8^{2-}$ and I^-).
9. Verification of Freundlich adsorption isotherm (Adsorption of oxalic acid on Charcoal).
10. Estimation of KI by partition method.

II. Viva-Voce **- 5marks**

Scheme of Valuation

Procedure with formula	- 10 marks
Up to 5%	- 65 marks
5 - 10%	- 55 marks
10 – 15 %	- 45 marks
> 15 %	- 35 marks

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	P S Sindhu	Practicals in Physical Chemistry	1st Edition	Macmillan, India	2006	All

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	Findlay. A	Practical Physical Chemistry	7th Edition	Longman, London	1959	All

Web Reference:

1. https://books.google.co.in/books/about/Practicals_in_Physical_Chemistry.

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**	
III	20PCH3CC12P		Physical Chemistry Non-Electrical Practical			6			4	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =45, Relationship: Very High										

Prepared by:
1. Dr. A. Jafar Ahamed
2. Dr. S. Mohamed Rabeek

Checked by:
Dr. M. Seeni Mubarak

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal marks	External marks
III	20PCH3DE3A	Discipline Specific Elective - III	MEDICINAL CHEMISTRY	6	4	100	25	75

Course Outcomes (COs):

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

1. Classify the Sources, imbibe the important terminologies and assay of drugs.
2. Sort out the metabolism of drugs and Drug Administration.
3. Ascertain the activity of drugs by QSAR methods.
4. Design the synthesis of drugs and Estimation of glucose and cholesterol.
5. Examine the Antibacterial drugs and anti cancer drugs.

UNIT – I **18 hours**

Drugs

1.1. Definition, nature, sources and classification of drugs – Important terminologies in medicinal chemistry - pharmacology, pharmacy, pharmacodynamics, pharmacokinetics, molecular pharmacology, pharmacophore, metabolites, antimetabolites, pharmacopoeia, pharmacognosy, toxicology, pharmacotherapeutics, LD50, ED50, therapeutic index - Assay of drugs – chemical, biological and #**immunological assay**#. Storage of pharmaceutical substances – types of storage, encapsulation – hard and soft gelatin capsule.

1.2. Mechanism of different types drug action- depression–stimulation- replacement –anti infective agent – metabolite antagonisists – physical and chemical properties of drugs.

UNIT – II **18 hours**

Metabolism of Drugs

2.1. Metabolism of drugs – Definition, mechanism of drug action- actions of cellular and extra cellular sites–-absorption of drugs – Factor that affect absorption -Routes of drug administration – adverse effect of drugs.

2.2.#**Phase I reactions**# - hydroxylation, oxidative de-alkylation, oxidative, deamination and-N- oxidation**.** #**Phase II reactions**#– glucuronide conjugation, amino acid, sulphate, Methylated and N- acetylated conjugates.

UNIT – III **18 hours**

Drug Design and Development

3.1. Developmentof new drugs – factors affecting development of new drugs concept of QSAR and parameters -Hansch and Wilson method.

3.2. Structure Activity Relationship- Effect of alkyl groups-unsaturation - chain length – isomerism – halogens – amino group – acidic group – hydroxyl group –Nitro and nitrite group- aldehydes and ketones. #**SAR of penicillin and streptomycin**#

UNIT – IV **18 hours**

Drug synthesis and Diagnostic aids

4.1. Structure and synthesis: Cardiovascular drugs – Nifedipine, Captopril, Clofibrate and Warfarin. Analgesic and Antipyretic drugs – Mefenamic acid, Dicofenac, Paracetamol and Asprin**.** Psychoactive drugs – Diazepam and Alprazolam.

4.2.Diabetics- causes of diabetics- Determination of Glucose – Folin & Wu's and *o*-toluidine methods. Determination of Cholesterol - Sackett's method, #**Estimation of hemoglobin**#**.** Radiopharmaceuticals for scintigraphy,-Radiopaques- types of radiopaques - radiopaques substances –radiographic procedure.Iopanoic acid – structure and mode of action.

UNIT – V **18 hours**

Antibacterial, Antitubercular and Anticancer Drugs

5.1.Antibacterial agents – Mechanism of action of sulpha drugs –preparation, properties and uses of Sulphanilamide, sulphadiazine, sulphapyridine, sulphathiazole and sulphafurazole. Tuberculosis, antitubercular drugs, synthesis, mode of actions and side effects of para amino salicylic acid, ethionamide, isoniazid and ethanbutol.

5.2. Anticancer drugs - Cancer - types of cancer - causes of cancer- treatment of cancer- **#cytotoxic agents – antimetabolities - radio active substances#**. - Quinidine, Procainamide and Propanolol Hydrochloride - mustard drugs- mechlorethamine- synthesis -uses- cyclophosphamide -synthesis –uses.

------- **#** Self study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Jayashree Ghose	Text book of Pharmaceutical chemistry	3rd Revised Edition	S. Chand, New Delhi	2008	I-II
2.	Wilson and Giswalds	Textbook of Organic Medicinal and Pharmaceutical Chemistry	1st Edition	Lippincott Williams & Wilkins	2010	V
3.	S C Matha Ashutosh Kar	Pharmaceutical Pharmacology	1st Edition	New Age International PVT limited, New Delhi	2009	I-V
4.	Alka l.Gupta	Medicinal Chemistry	10th Edition	Pragati Prakashan, New Delhi	2020	I-V

REFERENCES:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Mathew George and Lincyjoseph	Text book of Pharmaceutical Chemistry	1st Edition	Abe books, New Delhi	2009	I-II
2.	S.Lakshmi	Pharmaceutical Chemistry	3rdEdition	Sulthan Chand and Sons, New Delhi	2009	III-IV
3.	Gareth Thomas	Medicinal Chemistry	2nd Edition	John Wiley & Sons: Chichester, New Delhi	2011	V
4.	Graham L. Patric	An introduction to Medicinal Chemistry	3rd Edition	Oxford University Press, USA	2005	I-V

5.	Richard B. Silverman	The Organic Chemistry of Drug Design and Drug Action	2nd edition	Academic Press, US	2004	I-V

Web References

1. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908
2. https://nptel.ac.in/courses/104/106/104106106/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Course**			**Hours**			**Credits**	
III	**20PCH3DE3A**		**MEDICINAL CHEMISTRY**			6			4	
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =43, Relationship: High										

Prepared by:
1. Dr. S.S. Syed Abuthahir
2. Dr. H. Mohamed Kassim Sheit

Checked by:
Dr. A. Zahir Hussain

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal marks	External marks
III	20PCH3DE3B	Discipline Specific Elective – III	CHEMISTRY OF MATERIALS	6	4	100	25	75

Course Outcomes (COs):

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

1. Describe the electric and magnetic properties of inorganic solids.
2. Develop the superconductor materials.
3. Apply the inorganic materials in biomedical field.
4. Appreciate the uses of metal complexes in photochemistry.
5. Explain the structure of crystal using diffraction studies.

UNIT – I **18 hours**

Synthesis of Inorganic Materials

1.1. Synthesis of materials – formation of bulk material – methods – direct synthesis – solution method - chemical deposition - Defects and ion transport - extended defects – atom and ion diffusion.

1.2. Solid Electrolytes – cationic electrolytes- anionic electrolytes-**#Mixed ionic electronic conductors#**- properties, structure and uses.

1.3. Magnetic materials - Atomic magnetism and solids, type of magnetic materials, exchange interactions, hysteresis loop and classification, calculation of magnetic moment from saturation magnetisation, magnetic domains, examples of magnetic materials - soft & hard ferrites - structure & magnetic interactions in spinel, garnet hexagonal ferrites, Applications of magnetic materials.

UNIT – II **18 hours**

Superconductors and Inorganic Pigments

2.1. Superconductors – high temperature super conductors – Meissner effect – types - super conducting oxides - properties – colossal magnato resistance – structure – properties – rechargeable battery materials – $LiCoO_2$, $LiMnO_4$ – properties and uses.

2.2. Superconducting materials - Definition, superconductivity, critical temperature, critical field, **#BCS theory#,** properties & classification of superconductors, high T_c superconductors, examples with structure and applications, fullerenes, intermetallic superconductors, synthesis and applications.

2.3. Inorganic pigments: Coloured solids – inorganic phosphorous – properties- uses – white and black pigments – properties and uses.

UNIT – III **18 hours**

Molecular Material Chemistry

3.1. Molecular material Chemistry – one dimensional metals – properties and uses – molecular inorganic magnetic materials – properties and uses.

3.2. Inorganic liquid crystals – types – calamitic –discotic – properties and uses. **#Fullerides - solid carbon C60 – properties and uses#**.

3.3. Biomaterials - Definition, Dense Hydroxyapetite ceramics, bioactive glasses, bioactive glass ceramics and bioactive Composites.

UNIT – IV **18 hours**

Inorganic Photochemistry

4.1. Inorganic Photochemistry: Electronic transitions in metal complexes, metal centred and Charge-transfer transitions- various photophysical and photochemical processes of coordination compounds.

4.2. Unimolecular charge transfer photochemistry of cobalt (III) complexes- mechanism of CTTM, photoreduction- ligand field photochemistry of chromium (III) complexes - Adamson's rule, photoactive excited states, V-C model- photo physics and photochemistry of ruthenium- polypyridine complexes, emission and redox properties.

4.3. Photochemistry of organometallic compounds- metal carbonyl compounds- compounds with metal-metal bonding-**#Reinecke's salt chemical actinometer#.**

UNIT – V **18 hours**

Diffraction Studies of Crystals

5.1. X-ray diffraction by single crystal method: Space groups- systematic absences in X-ray data and identification of lattice types, glide planes and screw axes- X-ray intensities- structure factor and its relation to intensity and electron density- phase problem- structure solution by heavy atom method and direct method- determination of absolute configuration of molecules-a brief account of Cambridge structural database (CSD) and protein data bank(PDB).

5.2. Electron diffraction by gases- scattering intensity vs. Scattering angle, **#Wierl equation- Measurement techniques#.**

5.3. Neutron diffraction by crystals – magnetic scattering- measurements techniques- elucidation of structure of magnetically ordered unit cell.

#_____# Self study

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Shriver and Atkins	Inorganic Chemistry	5th Edition	Oxford University press, New Delhi, India,	2011	I -III
2.	A.W. Adamson	Concept of Inorganic Photochemistry	1st Edition	John Wiley and sons, New York	1975	IV
3.	A. Abdul Jameel	Application of Physical Methods to Inorganic Compounds	1st Edition	Jan Publications, Tiruchirappalli	2007	V

REFERENCES:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Stuart Warren	Organic synthesis methods and starting materials, the disconnections approach	1st Edition	John, Wiley & sons, New York	1992	I -III
2.	Futhrhop, Penzlin	Photochemistry	1st Edition	John Wiley and sons, New York	1992	IV
3.	Shriver and Atkins	Inorganic chemistry	5th Edition	Oxford university press, India	2011	V

Web References

1. https://swayam.gov.in/nd1_noc19_ph08/preview
2. https://swayam.gov.in/nd1_noc20_ph06/preview
3. https://nptel.ac.in/courses/116/102/116102052/
4. https://nptel.ac.in/courses/113/106/113106069/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
III	**20PCH3DE3B**	**CHEMISTRY OF MATERIALS**	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓		✓	✓	✓	✓		✓	✓
CO2		✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3		✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓		✓	✓	✓	✓
Number of matches (✓) =42, Relationship: High										

Prepared by:
1. Dr. S.S. Syed Abuthahir
2. Dr. H. Mohamed Kassim Sheit

Checked by:
Dr. A. Zahir Hussain

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4CC13	Core-XIII	CLASSICAL, STATISTICAL THERMODYNAMICS AND SURFACE PHENOMENA	6	5	100	25	75

Course Outcomes (COs):

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

1. Explain the fundamentals of thermodynamics
2. Interpret partition function and calculate thermodynamic properties
3. Predict macroscopic properties of a system
4. Construct and explain phase diagram for multi-component system
5. Describe surface phenomena

UNIT – I **18 hours**

Classical Thermodynamics:

1.1. Thermodynamics of systems of variable composition (Open Systems) - partial molar property – partial molar quantities of E, V, H, A, G and S, chemical potential, physical significance of chemical potential, variation of chemical potential with respect to T and P, chemical potential in terms of U and H, partial molar quantities from experimental data – direct method, apparent molar properties, intercepts method and general methods.

1.2. Calculation of thermodynamic properties of real gases - fugacity concept, variation of fugacity with T and P– Lewis-Randall rule–calculation of fugacity of real gases, determination of fugacity – graphical method, equation of state method, determination of fugacity in gas mixtures

1.3. Activity of non-electrolytes – definition, activity coefficient, standard states of solvent and solute for liquids and solids, dependence of activity on T and P, experimental determination of activity (solvent and solute) – vapour pressure method, **#cryoscopic method and EMF method#.** (Problems from 1.1- Enthalpy, entropy, free energy calculations and 1.3- activity coefficient)

UNIT – II **18 hours**

Statistical Mechanics

2.1.Basic Concepts and Classical Statistics – introduction of statistical mechanics, mathematical probability, thermodynamic probability, relation between mathematical probability and thermodynamic probability of a system, Boltzmann-Planck's equation, Phase space, Ensembles – types of ensembles, definition of micro and macro states, different methods of counting macro states, postulates, Ergodic hypothesis, distinguishable and indistinguishable particles, Stirling's approximation.

2.2.Classical statistics – derivation of Maxwell–Boltzmann statistics and distribution law,

Partition functions – Definition, derivation of translational, rotational, vibrational and electronic partition functions, principle of equi-partition of energy.

2.3. Molar partition function and molecular partition function, partition functions and thermodynamic quantities - Internal energy (E), heat capacity (Cv), work function (A), pressure (P), entropy of mono atomic gases (Sackur–Tetrode equation)**#heat content (H), Gibb's free energy(G) and entropy(S) #.** (Problems from 2.3)

UNIT –III **18 hours**

Quantum Statistics

3.1.Quantum statistics – Bose–Einstein and Fermi–Dirac statistics and distribution function, comparison of them with Maxwell-Boltzmann statistics,

3.2. Application of B.E statistics - photon gas and super fluidity of liquid helium, concept of negative Kelvin temperature, application of F.D statistics - electron gas and thermionic emission.

3.3.Heat capacities of solids – Dulong and Petit's law, classical theory and its limitations, Einstein's theory and its limitations, Debye's theory and its limitations.

UNIT-IV **18 hours**

4.1. Irreversible Thermodynamics

Non-equilibrium thermodynamics – Definition, types of irreversibility of a process, postulates, entropy production - entropy production and rate in a chemical reaction, Onsagar relations - linear law, reciprocal relation and applications, stationary–state.

4.2. Phase rule-Three component system

Maximum number of phases, maximum number of F, Roozeboom triangle-Types-formation of one pair partially miscible liquids (acetic acid-chloroform-water),formation of two pairs of partially liquids (water-phenol-aniline) and formation of three pairs of partially miscible liquids (succinic nitrile- water- ether).

4.3.Solid liquid systems

Ammonium chloride - Ammonium nitrate - Water system **# H_2O - Na_2SO_4 – NaCl system and $MgCl_2$, $CaCl_2.H_2O$ system#.**

UNIT-V **18 hours**

Surface Phenomena

5.1. B.E.T. isotherms - Surface area determination - Heat of adsorption and its determination Adsorption from solution, Gibbs adsorption isotherm - solid - liquid interfaces - wetting and contact angle - solid gas interfaces - soluble and insoluble film.

5.2 Surface tension - methods of measuring surface tension - electrical phenomenon at Interfaces, including electro kinetic, micelles and reverse micelles, Solubilisation, Micro - emulsions. (Problems from 5.1-Surface area determination & 5.2-Surface tension)

5.3 Role of surface in catalysis - **#semiconductor catalysis, n and p type surfaces#** - kinetics of surface reactions involving adsorbed species - Langmuir - Hinshelwood mechanism**.**

 # …..# Self study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	K. Kuriacose and J.C. Rajaram	"Thermodynamics for students of Chemistry"	3rd Edition	Shoban Lal Nagin Chand & Co, Delhi.	2002	I
2.	Gurdeep Raj	Thermodynamics, Statistical Thermodynamics and	3rd Edition	Goel Publishing House, Meerut.	2004	II &III

		Irreversible thermodynamics				
3.	M. C. Gupta	Statistical Thermodynamics	2nd Edition	New Age International Limited, New Delhi	2003	II, III &IV
4.	Laider	Chemical kinetics	3rd Edition	Tata-McGraw Hill Co., New Delhi.	1984	V
5.	R. Kh. Dadashev	Thermodynamics of Surface Phenomena	1st Edition	Viva Books Pvt. Ltd, New Delhi.	2017	V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	F. W. Sears	Statistical Mechanics	2nd Edition	Addison Wesley	1972	I & III
2.	H. W. Zemansky	Heat and Thermodynamics	8th Edition	Tata- McGraw Hill, New Delhi.	1975	I, II, III & IV
3.	P. W. Atkins	Physical Chemistry	6th Edition	Oxford University Press, New Delhi	1998	I, III & V
4.	Samuel Glasstone	Textbook of Physical Chemistry	2nd Edition	Macmillan India, New Delhi.	1981	I & II
5.	K. L. Kapoor,	A Text Book of Physical Chemistry	1st Edition	Macmillan India Press, Chennai.	2009	II & V

Web Reference:

https://nptel.ac.in/courses/104/103/104103112/
https://nptel.ac.in/courses/122/101/122101001/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
IV	20PCH4CC13	CLASSICAL, STATISTICAL THERMODYNAMICS AND SURFACE PHENOMENA	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓		✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓			✓	✓	✓	
CO4		✓	✓	✓			✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	
Number of matches = 35 (70%) , Relationship: High										

Prepared by:
Dr. M. Syed Ali Padusha

Checked by:
Dr. M. Seeni Mubarak

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4CC14	Core-XIV	CHEMISTRY OF MACROMOLECULES	6	5	100	25	75

Course Outcomes (COs):

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

1. Understand the rudiments of the polymers and mechanism of-polymerization reactions
2. Calculate the molecular weight of polymers
3. Appraise the properties of polymers
4. Predict the structure of the polymers using FT-IR, UV-Visible and NMR spectral studies and investigate the surface morphology and crystalline lattice of polymers
5. Highlight the application of polymers

UNIT-I **18 Hours**

Introduction of Macromolecular Chemistry

1.1 #**Historical development of polymer chemistry, monomer, polymer, oligomer, degree of polymerization**#, characteristics of polymer, raw materials for polymers, concept of functionality, nomenclature, Classification – based on sources, molecular forces, reactions and structure. Chain-growth and step-growth polymerization, Stereo regular polymers. Chain transfer reaction.

1.2 Kinetics and mechanism: Free radical, Ionic, Coordination and Co-polymerization.

1.3 Polymerization Techniques - Bulk, Solution, Suspension and Emulsion polymerizations.

UNIT-II **18 Hours**

Molecular Weight Determination and Characterization of Polymers

2.1 #**Concepts of Molecular weight - number, weight**# and viscosity averages – Polydispersity index and molecular weight distribution - Practical significance of molecular weight

2.2 Determination of molecular weight of polymers by End group analysis, Membrane Osmometry, Vapour Phase Osmometry, Viscometry, Light scattering measurements and gel permeation chromatography

2.2 Characterization of polymers by IR and NMR spectroscopy, X-ray diffraction studies, Scanning Electron Microscopy and Transmission Electron Microscopy.

UNIT-III **18 Hours**

Properties of Polymers

3.1 Physical properties - Hardness, tensile strength, fatigue, impact, tear resistance and abrasion resistance. Polymer structure and property relationship - effect of chain flexibility and other steric factors.

3.2 Glass transition temperature (T_g), melting point (T_m), factors influencing T_g and T_m, relationship between T_g and T_m. Crystallinity in polymers - Polymer crystallisation, structural and other factors affecting crystallisability, effect of crystallinity on the properties of polymers.

3.3 Degradation of polymers - thermal, photo, mechanical and oxidative degradations. #**Preventing methods of polymer degradation**#**.** Thermo Gravimetric Analysis, Differential Thermal Analysis – Basic concepts

UNIT-IV **18 Hours**

Processing of Polymers

4.1 Natural rubber: Production, constitution, vulcanization (hot and cold), fillers and accelerators, antioxidants. #**Elastomers, plastics and fibres - thermosetting and thermoplastics**#

4.2. Thermoplastic elastomers materials – Types, properties, compounding and applications

4.3 Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT-V **18 Hours**

Commercial polymers and their applications

5.1 Preparation, properties and applications of polymethylmethacrylate (PMMA), polyamides (Nylon-6, Nylon-6,6, Nylon-6,10), aromatic polyesters, epoxy resins, Phenol-formaldehyde resins, Urea-formaldehyde resins, Melamine-formaldehyde resins.

5.2 Speciality polymers - Conducting polymers, Ionomers, Polymer composites, Thermally stable polymers and Liquid crystalline polymers – Applications

5.3 Biomedical polymers - contact lens, dental, artificial heart, artificial kidney, #**artificial skin and artificial blood cells**#

#_____# Self study

Textbooks:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	R. Gowariker, N.V. Viswanathan and J. Sreedhar	Polymer Science	3rd Edition	New Age International Publishers, New Delhi	2019	I-IV
2.	M.S. Bhatnagar	A Textbook of Polymer Chemistry	5th Edition	S.Chand & Company Ltd. New Delhi	2014	I-IV
3.	M.S. Bhatnagar	A Textbook of Polymers, Vol.-I Chemistry and Technology of Polymers (Basic Concepts)	28th Edition	S.Chand & Company Ltd., New Delhi	1999	I-III
4.	G.S. Mishra	Introductory Polymer Chemistry	1st Edition	New Age International (P) Ltd., Publishers,New Delhi	1993 Reprint-2005	I-IV
5.	Anshu Srivastava, Shakun Srivastava	Fundamentals of Polymer Science & Technology	1st Edition	S.K. Kataria & Sons Publishers, New Delhi	2012	I-V
6.	Alka L. Gupta	Polymer Chemistry	4th Edition	A Pragati Edition, Meerut	2015	I-V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	F. W. Billmeyer	Textbook of Polymer Science	3rd Edition	John Wiley and Sons, New York	2003	I, II &IV
2.	H. F. Haufman, J.J. Falcetta	Introduction of Polymer Science and Technology	An SPE Text Book (Edn.)	John Wiley and Sons, New York	1977	I, II &IV
3.	P. Bahadur, N.V. Sastry	Principles of Polymer Science	2nd Edition	Narosa Publishing House (P) Ltd., New Delhi	2015	I-IV
4.	Charles E. Carraher Jr.	Introduction to Polymer Chemistry	3rd Edition	CRC Press, Taylor & Francis group, UK	2012	I, II & IV

5.	J. R. Fried	Polymer Science and Technology	3rd Edition	Pearson Prentice Hall, US	2014	I-IV
6.	Robert J. Young, Peter A. Lovell	Introduction to Polymers	3rd Edition	CRC Press, Taylor & Francis group, UK	2011	I-V

Web Reference:

1. https://nptel.ac.in/courses/113/105/113105077

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Course**			**Hours**				**Credits**
IV	**20PCH4CC14**		**Chemistry of Macromolecules**			**6**				**5**
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO2		✓	✓		✓	✓		✓	✓	✓
CO3	✓	✓	✓		✓	✓			✓	✓
CO4	✓	✓	✓		✓	✓		✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓
Number of Matches = 40, Relationship : High										

Prepared by:
1. Dr. S. Farook Basha
2. Dr. N. Mujafarkani

Checked by:
Dr. A.N. Mohamed Kasim

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4CC15P	Core – XV	PHYSICAL CHEMISTRY ELECTRICAL - PRACTICAL	6	5	100	20	80

Course Outcomes (COs):

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

1. Estimate the strength of mixture of acids and bases using principles of conductometry and potentiometry.
2. Determine the solubility product to apply the Ostwald's dilution law
3. Apply the Kohlrausch's law to identify the nature of acid
4. Determine the of strengths of acid mixtures and halide mixtures
5. Explain the CMC and determine the hydrolysis constant using conductometry and potentiometry.

List of Practicals

I. ELECTRICAL PRACTICALS -75 marks

CONDUCTOMETRY:

1. Estimation of mixture of acids.
2. i. Determination pK_a – Ostwald's dilution law.
   ii. Determination of solubility product - Kohlrausch's law.
3. Estimation of mixture of halides.
4. Determination of hydrolysis constant (for aniline hydrochloride)
5. i. Saponification of ethyl acetate (Kinetics study).
   ii. Determination of critical micellar concentration by conductometric method.

POTENTIOMETRY:

1. Estimation of mixture of acids.
2. Determination of solubility product by
   a) Galvanic cell method.
   b) Concentration cell method.
3. Estimation of mixture of halides.
4. Determination of E^0 of Zn / Zn^{2+} and Estimation of Zn
5. Determination of hydrolysis constant (for aniline hydrochloride)

II. Viva-Voce -5marks

Scheme of valuation

Procedure with formula : 10 marks
Practical : 65 marks

<1%	-	65 marks
1-2%	-	55 marks
2-3%	-	45 marks
3-4%	-	35 marks
>4%	-	25 marks

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	P S Sindhu	Practicals in Physical Chemistry	1st Edition	Macmillan, India	2006	All

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	A. Findlay	Practical Physical Chemistry	7th Edition	Longman, London,	1959	All

Web Reference:

1. https://books.google.co.in/books/about/Practicals_in_Physical_Chemistry.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
III	20PCH4CC15P	Physical Chemistry Electrical Practical	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓		✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =45,						Relationship: Very High				

Prepared by:
1. Dr. A. Jafar Ahamed
2. Dr. S. Mohamed Rabeek

Checked by:
Dr. M. Seeni Mubarak

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4DE4 A	DSE - IV	GREEN AND NANO CHEMISTRY	6	4	100	25	75

Course Outcomes (COs):

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

1. Apply the role of green chemistry and its importance in environment.
2. Get familiar with carrying out chemical reactions in green approach.
3. Revise the conventional method of preparation of chemical products applying green principles
4. Understand the concepts of nanomaterials, their synthesis and characterization.
5. Acquire knowledge on CNT and their applications.

UNIT-I **18 hours**

Green Chemistry:

1.1 Definition- Need for green chemistry- Twelve principles of green chemistry-pollution control and pollution prevention – green methods, green products, recycling of waste. concept of atom economy – efficiency of reaction – #**percentage yield – Theoretical yield**#.

1.2 Atom economy in substitution, elimination, addition and rearrangement reactions - Atom economy calculation of ethylene oxide and Ibuprofen.

UNIT-II **18 hours**

Green Reactions:

2.1 Green solvents –definition, super critical carbon dioxide, role of Ionic liquids, #**Use of water as solvent**#, applications of zeolites in green chemistry. Organic synthesis – microwaves and sonication methods –benefits and limitations.

2.2 Designing a green synthesis – choice of starting material, reagents, catalysts and solvents. PTC catalyzed reactions (Williamson ether synthesis and Wittig reaction).

UNIT-III **18 hours**

Green Synthesis:

3.1 Adipic acid, catechol, methyl methacrylate, acetaldehyde, Ibuprofen and Paracetamol. Microwave assisted reaction in water – Hofmann eliminations, Hydrolysis and Oxidation. Microwave assisted reaction in organic solvents- Esterification, Fries rearrangement, Decarboxylation and Diels – Alder reaction.

3.2 Ultrasound assisted reaction: Definition, Cannizaro reaction, Strecker synthesis and Reformatsky reaction.

UNIT-IV **18 hours**

Nano Materials:

4.1 Introduction – Historical milestones- classification, properties – #**Optical, electrical, mechanical and magnetic properties**#. Applications - nanomaterials in medicine, information storage, sensors, new electronic devices, environmental remediation and clean catalysts.

4.2 Synthesis - Bottom up, Top down approach – Hydrothermal, Sol- gel and Solvothermal methods. Characterisation of nanomaterials by SEM, TEM and AFM.

UNIT-V **18 hours**

Carbon Nanotubes:

5.1 CNT –definition- Classification – Single wall and Multiwall CNTs (SWCNT and MWCNT). Preparation - arc method, laser ablation method, Chemical vapour deposition method, Electro-deposition method, Ball milling method.

5.2 SWCNT and MWCNT – Properties- applications. #**Fullerenes**# – properties – uses. Nanocomposites – Classification, Properties and uses.

#------- # Self study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	V.K. Ahluwalia	Green Chemistry	3rd Reprint	Narosa Publishing House Pvt Ltd., Delhi	2018	I, II & III
2	Sulabha K. Kulkarni	Nanotechnology, Principles and Practices	1st Edition	Capital Pvt. Co., Delhi	2002	IV & V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	R.Sanghi and M.M Srivastva	Green chemistry	5th Reprint	Narosa Publications, India	2012	I, II & III
2	Kenneth, J. Klaburde	Nanoscale materials in chemistry	2nd Edition	John Wiley and Sons	2002	IV & V
3	Richard Booker and Earl Boysen	Nano technology	1st Edition, Reprint	Wiley India Pvt Ltd.	2010	IV & V

Web Reference: 1. https://iopscience.iop.org/book/978-0-7503-1221-9/chapter/bk978-0-7503-1221-
2. https://en.wikipedia.org/wiki/Green_nanotechnology

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Course			Hours			Credits	
IV	20PCH4DE4 A		Green and Nano Chemistry			6			4	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	✓
CO2	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =45,							Relationship: Very High			

Prepared by:
1. Dr. R. Abdul Vahith
2. Dr. M. Varusai Mohamed

Checked by:
1. Dr. A. Jafar Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4DE4B	DSE–IV	ENVIRONMENTAL CHEMISTRY AND QUALITY CONTROL	6	4	100	25	75

Course Outcomes (COs):

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

1. Gain knowledge on food quality measurements
2. Familiar with different types of renewable energy sources
3. Analyse water quality parameters
4. Describe the harmful effects of radioactive pollution.
5. Produce value added products from waste materials

UNIT – I **18 hours**

Quality Control Measurements

1.1 Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate – Food adulteration – common adulterants in food, contamination of food stuffs – Microscopic examination of foods for adulterants – Pesticides analysis in food products – analysis of toxic metals in food (Mercury, cadmium, cobalt, tin and chromium).

1.2 Determination of iodine, Saponifiction and acid value of an oil – #**Food standards – ISI and Agmark**#.

UNIT – II **18 hours**

Energy Sources – Non Conventional

2.1 Solar energy – Technologies based on capture of heat from sun light – solar water heating systems – solar air conditioning. Technologies for converting solar energy to electricity – heat engines, photo voltaic – principle and operation. Wind energy – wind mills – wind farm siting and properties – storage. Tidal energy – advantages and limitations of tidal power generation.

2.2 Environmental impact of renewable energy sources. Bio mass energy sources – advantages – #**Fuel cell – hydrogen-oxygen fuel cell, Hydrocarbon-oxygen fuel cell**#.

UNIT –III **18 hours**

Water Pollution and its Control Analysis of Water Pollution

3.1 Sources of water pollution – domestic – industrial – agricultural – soil and radioactive wastes as sources of pollution. Water pollutants and their effects. Objectives of analysis – parameters for analysis-colour – turbidity – total solids – conductivity – acidity – alkalinity – hardness – chloride – sulphate – fluoride – silica – phosphates, different forms of nitrogen, DO, BOD, COD.

3.2 Heavy metal pollution-public health significance of cadmium – chromium – copper – lead – zinc– manganese – mercury and arsenic. Prevention and control measures.

UNIT –IV **18 hours**

Radioactive and Thermal Pollution

4.1 Radioactivity and kinds of radiation – #**Sources of radioactive pollution**# – Radio waste generated by nuclear power plants – Harmful effects of radiation – Dangers from nuclear power plants – Disposal methods of radioactive wastes.

4.2 Source of thermal pollution – Thermal power plant pollution – Hazardous effect – Prevention and control of thermal pollution.

UNIT – V **18 hours**

Wealth from Waste (Recycling):

5.1 Introduction – Recycling Techniques – Construction materials from waste – Medicines from agricultural waste – Liquid fuels from agricultural waste – Urban waste and bagasse for electricity – Agriculture waste for biomass into cheap and efficient fuel.

5.2 Bacteria for paper making – Waste into objects of daily use – Garbage into fuel – How to use garbage to generate power.

#-------- # Self study

Text Books:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	H. Kaur	Environmental Chemistry	9th Edition	Pragati Prakashan, Meerut, India	2015	I,II&III
2.	B.K. Sharma	Instrumental Methods of Chemical Analysis	13th Edition	Goel Publishing House, Meerut, India	2001	I,III&V
3.	B.K. Sharma	Industrial Chemistry	13th Edition	Goel Publishing House, Meerut, India	2015	II,III,IV&V

Books for Reference:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1	S.A. Abbasi and Naseema Abbasi	Renewable energy sources and their environmental Impact	2nd Edition	Prentice-Hall, New Delhi	2002	II,IV & V
2	H. Kaur	Instrumental Methods of Chemical Analysis	8th Edition	Pragati Prakashan, Meerut. India	2001	I &III

Web Reference:

1. https://pubs.acs.org/doi/abs/10.1021/ed076p1642
2. https://www.envstd.com/services/chemistry-qa/

Mapping:

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
IV	20PCH4DE4B	Environmental Chemistry and Quality Control	6	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓		✓	✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓		✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 45, Relationship: Very High										

Prepared by:

1. Dr. R. Abdul Vahith
2. Mr. M. Varusai Mohamed

Checked by:

1. Dr. A. Jafar Ahamed

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal Marks	External Marks
IV	20PCH4EC2	Extra Credit Course -II	Chemistry for Career Examinations	-	5	100	-	100

Course Outcomes (COs):

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

1. Familiar with laboratory safety rules and regulation
2. Categorize the nature of solvents
3. Apply suitable reagents for organic synthesis
4. Analyse the reaction progress and purity of the samples
5. Solve and generate the molecular structure of the organic compounds.

UNIT-I **18 hours**

ChemSafeLab

Introduction – safety symbols in the laboratory – symbols and their meaning –material safety data sheet (MSDS) – Globally harmonized system of classification and labeling of chemicals (GHS) – Globally chemical abstracts service (CAS) registry number - Chemical Hygiene Plan Accessibility- Basic laboratory safety practices - Chemical Inventory and MSDSs/SDSs - Chemical Procurement - Chemical labeling.

UNIT-II **18 hours**

Solvents used in laboratories

General properties, applications and health hazards of methanol, ethanol, methylene chloride, chloroform, carbon tetrachloride, benzene, toluene, petroleum ether, diethyl ether, acetone, 1,4-dioxane, acetic acid, ammonia, triethyl amine and water.

UNIT-III **18 hours**

Common Reagents used in Organic Synthesis

Oxidation: Jones reagent, PCC, PDC, IBX, DMP, CAN, TPAP, NOCl, $Mn(OAc)_3$, $Cu(OAC)_2$ and Bi_2O_3.

Reduction: palladium / platinum / rhodium / nickel based heterogeneous catalysts for hydrogenation.

Hydride transfer reagents from group III and group IV in reductions. (i) triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, Red-Al, $NaBH_4$ and $NaCNBH_3$, trialkylsilanes and trialkylstannane, (ii) stereo/enantioselectivity reductions (Chiral Boranes, Corey-Bakshi-Shibata).

UNIT-IV **18 hours**

Separation and Purification Techniques

Solvent extraction – Principles of ion exchange, paper, thin-layer and column chromatography techniques – columns, adsorbents, methods, R_f values, Mc Reynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques – methods, principles and uses.

UNIT-V **18 hours**

Spectral Characterization of Organic Compounds

Characterization of organic molecules by UV-Visible, IR, ^{1}H-NMR, ^{13}C-NMR and Mass spectroscopic techniques.

TEXT BOOKS:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	S. B. Pal	Handbook of Laboratory Health and Safety Measures	2nd Edition	Springer Netherlands	1990	I

2.	S. Furnis, S. Brian, Hannaford and J. Antony	Vogels Textbook Of Practical Organic Chemistry	5th Edition	Pearson, New Delhi	2016	II
3.	Francis A. Carey and Richard J. Sundberg	Advanced Organic Chemistry, Part B: Reaction and Synthesis	First Indian Reprint	Springer India Private Limited, New Delhi	2012	III
4.	H. Kaur	Instrumental Methods of Chemical Analysis	1st Edition	Pragati Prakashan, New Delhi	2012	IV
5.	P. S. Kalsi	Spectroscopy of Organic Compounds	Reprint	Macmillan India Limited, New Delhi	2008	V

BOOKS FOR REFERENCE:

S. No.	Author Name	Book Name	Edition	Publisher detail	Year	Units Covered
1.	Phillip Carson & Clive Mumford	Hazardous Chemicals Handbook	2nd Edition	Replika Press Pvt. Ltd, New Delhi- 110 040, India Printed and bound in Great Britain	2002	I
2.	Christian Reichardt	Solvents and Solvent Effects in Organic Chemistry	3rd Edition	Wiley Publication, England	2003	II
3.	W. Carruthers and Iain Coldham	Modern Methods of Organic Synthesis	4th Edition	Cambridge University Press, UK	2004	III
4.	Willard, Merritt, Dean and Settle	Instrumental Methods of Analysis	7th Edition	CBS Publishers, New Delhi	1986	IV
5.	Jag Mohan	Organic Spectroscopy : Principles & Applications	Reprint	Narosa Publications, New Delhi	2020	V

Web References:

1. https://onlinecourses.swayam2.ac.in/ugc19_bt16/preview
2. https://onlinecourses.nptel.ac.in/noc20_cy23/preview

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course	Hours	Credits
IV	20PCH4EC2	Chemistry for Career Examinations	-	5*

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches = 47, Relationship : VERY HIGH										

Prepared by:

1. Dr. R. Abdul Vahith
2. Dr. A. Asrar Ahamed

Checked by:
Dr. M. Syed Ali Padusha

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high