KUNTHAVAI NAACCHIYAAR GOVT. ARTS COLLEGE FOR WOMEN
(AUTONOMOUS)

Thanjavur – 613 007, Tamil Nadu, India.
Re-Accredited by NAAC with 'B' Grade
Affiliated to Bharathidasan University

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CBCS & OBE
Scheme of Instruction and Syllabus for M.Sc., Chemistry

(I to IV Semester)
Effective from 2023-2024 Onwards

DEPARTMENT OF CHEMISTRY

KUNTHAVAI NAACCHIYAAR GOVT. ARTS COLLEGE FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF CHEMISTRY

I. VISION

1. To impart higher education to women.
2. To transform and empower the women students through education by enhancing the qualities of competence, confidence and excellence.

II. MISSION

1. To educate the students from the rural area qualitatively.
2. To create social awareness.
3. To enable rational thinking and social responsibility.
4. To empower the students to face the challenges and hurdles in their upcoming life.

III. PROGRAM OUTCOME (PO)

After successful completion of the two year degree program, a student should be able to

PO 1 : Indulge in deeper learning of the principle of organic,inorganic and physical chemistry.

PO 2 : Master factual and experimental knowledge across the principal areas of chemistry.

PO 3 : Acquires the ability to synthesis,separate and characterize the compounds using laboratory and instrumentation techniques.

PO 4 : Demonstrate, solve and understanding of major concepts in all disciplines of chemistry.

PO 5 : Learn Research methodology, analytical, spectroscopic tools and applications of various disciplines of chemistry.

PO 6 :Understand the role of chemistry in everyday life.

PO 7 : Develop critical thinking,analytical reasoning skill and Research skill.

PO 8 : Think rationally,systematically, independently to analyze the chemical problems and to draw a logical conclusion.

PO 9 : Ability to implement chemistry in an integral activity of social,economical and environmental problems.

PO10: Attain employability,entrepreneurial skills to find out the jobs and start the own industry respectively.

Programme Structure

M.Sc. Chemistry Course CBSE Structure with OBE (for the candidates admitted 2023-24)

Sem	Course	Existing Code	Title of the Paper	Ins. Hrs	Credit	Exam Hrs.	Marks		Total
							Int.	Ext.	
I	CC 1	23KP1CH01	Inorganic Chemistry – I	7	5	3	25	75	100
	CC 2	23KP1CH02	Organic Chemistry –I	7	5	3	25	75	100
	CC 3(P)	23KP1CH03P	Inorganic Chemistry Practical–I	6	4	6	25	75	100
	EC 1	23KP1CHECCH1P	Organic Chemistry Practical– I	5	3	6	25	75	100
	EC 2	23KP1CHECCH2:1/ 23KP1CHECCH2:2	Electro Analytical Chemistry/ Nano materials and Nano technology	5	3	3	25	75	100
	Total			**30**	**20**				**500**
II	CC 4	23KP2CH04	Organic Chemistry – II	6	5	3	25	75	100
	CC 5	23KP2CH05	Physical Chemistry – I	6	5	3	25	75	100
	CC 6 (P)	23KP2CH06P	Inorganic Chemistry Practical-II	6	4	6	25	75	100
	EC 3	23KP2CHECCH3P	Organic Chemistry Practical-II	4	3	6	25	75	100
	EC 4	23KP2CHECCH4:1/ 23KP2CHECCH4:2	Polymer Chemistry/Medicinal Chemistry	4	3	3	25	75	100
	SEC1	23KP2CHSEC1	Paint Chemistry	4	2	3	25	75	100
	ECC1	23KP2CHECC1:1	Fuel Chemistry	-	3	3	25	75	100
		23KP2CHECC1:2	MOOC						
	ECC2	23KP2CHECC2	Water Quality Analysis	-	4				
	Total			**30**	**22**				**600**
III	CC 7	23KP3CH07	Organic Chemistry – III	6	5	3	25	75	100
	CC 8	23KP3CH08	Inorganic Chemistry II	6	5	3	25	75	100
	CC 9	23KP3CH09	Spectroscopic Methods	6	5	3	25	75	100
	CC10 (P)	23KP3CH10P	Physical Chemistry Practical-I	6	4	6	25	75	100
	EC 5	23KP3CHECCH5:1/ 23KP3CHECCH5:2	Chemistry of Bio Molecules/Molecular Modeling and Drug Design	3	3	3	25	75	100
	SEC2	23KP3CHSEC2	Industrial Chemistry	3	2	3	25	75	100
		23KP3I	Internship/Industrial Activity	-	2				
	ECC3	23KP3CHECC3:1	Dye Chemistry	-	3	3	-	100	100
		23KP3CHECC3:2	MOOC						
	Total			**30**	**26**				**600**
IV	CC 11	23KP4CH11	Physical Chemistry – II	6	5	3	25	75	100
	CC 12	23KP4CH12	Inorganic Chemistry – III	6	5	3	25	75	100
		23KP4CHPW	Project with viva voce	10	7	6	-	100	100
	EC 6 (P)	23KP4CHECH6P	Physical Chemistry Practical-II related to Industry	4	3	6	25	75	100
	SEC3	23KP4CHSEC3	Research Methodology For Chemistry	4	2	3	25	75	100
		23KP4EA	Extension Activity	-	1	-	-		
	Total			**30**	**23**				**500**
	Grand Total			**120**	**91**				**2200**

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Semester	Courses	Total Papers	Ins.Hrs/Week	Credit
I	CC1,CC2,CC3(P), EC1, EC2	5	30	20
II	CC4,CC5,CC6(P), EC3, EC4, SEC1, ECC1, ECC2	8	30	22
III	CC7,CC8,CC9, CC10(P), EC5, SEC2, ECC3	7	30	26
IV	CC11,CC12,EC6(P), SEC 3, Project	5	30	23
	Total	**20**	**120**	**91**

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<table>
<tr><td>Title of the Course</td><td colspan="7">INORGANIC CHEMISTRY I</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>23KP1CH01</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To determine the structural properties of main group compounds and clusters.
To gain fundamental knowledge on the structural aspects of ionic crystals.
To familiarize various diffraction and microscopic techniques.
To study the effect of point defects and line defects in ionic crystals.
To evaluate the structural aspects of solids.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Structure of main group compounds and clusters: VB theory – Effect of lone pair and electronegativity of atoms (Bent’s rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachanoand klado; carboranes, hetero and metalloboranes; Wade’s rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Solid state chemistry – I: Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Solid state chemistry – II: Structural features of the crystal systems: Rock salt, zinc blende &wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Techniques in solid state chemistry: X-ray diffraction technique: Bragg’s law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.</td></tr>
<tr><td></td><td colspan="7"></td></tr>
</table>

	UNIT-V: Band theory and defects in solids Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012. 4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977. 5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.
Reference Books	1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199. 4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982. 5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.
Website and e-learning source	https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

CO1: Predict the geometry of main group compounds and clusters.
CO2: Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.
CO3: Understand the various types of ionic crystal systems and analyze their structural features.
CO4: Explain the crystal growth methods.
CO5:To understand the principles of diffraction techniques and microscopic techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC CHEMISTRY – I</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>23KP1CH02</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the feasibility and the mechanism of various organic reactions.
To comprehend the techniques in the determination of reaction mechanisms.
To understand the concept of stereochemistry involved in organic compounds.
To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
To design feasible synthetic routes for the preparation of organic compounds.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Methods of Determination of Reaction Mechanism: Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.</td></tr>
<tr><td colspan="7">UNIT-II: Aromatic and Aliphatic Electrophilic Substitution: Aromaticity: Aromaticity in benzenoid, non - benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and poly substituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.</td></tr>
<tr><td colspan="7">UNIT-III: Aromatic and Aliphatic Nucleophilic Substitution: Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.</td></tr>
<tr><td colspan="7"></td></tr>
</table>

	UNIT-IV: Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining the configuration. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereo isomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.
	UNIT-V: Stereochemistry-II: Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001. 2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959. 3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015. 4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013. 5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014.
Reference Books	1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007. 2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001. 3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987. 4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw

	Hill, 2000. 5. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2004.
Website and e-learning source	1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

CLO1: To recall the basic principles of organic chemistry.

CLO2: To understand the formation and detection of reaction intermediates of organic reactions.

CLO3: To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.

CLO4: To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.

CLO5:To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

Strong - 3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

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Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions.	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview.	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain.	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge.	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons.	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations.	

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.
The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

SEM I	CC 3(P)	INORGANIC CHEMISTRY PRACTICAL – I	23KP1CH03P	Ins.Hrs.6	Credit:4

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Categorize most common and less common ion by using semi-micro inorganic qualitative methods.	K6
2	Analyse the volumetric and quantitative estimations of mixtures of cations,	K4
3	Adapt and formulate suitable methods for the preparation of desire inorganic complexes.	K3
4	Learn the colorimetric analysis and estimation of some common metals,	K1
5	Understand the Beer-Lambert's law.	K2
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. Semi micro qualitative analysis of a mixture containing two common cations and two ions containing the following less familiar elements- Ti, W, Se, Tl, Mo, Ce, Th, Zr, V, Be, U, Li etc.
2. Colorimetric Estimation of Copper, Ferric, Nickel, Chromium and Manganese using photoelectric colorimeter.

References

1. Inorganic semi-micro quantitative analysis. V.V,Ramasamy. The National publishing house , Chennai., 1990.
2. Experimental inorganic chemistry, W.G. Palmer, Cambridge university press, Cambridge, 1965.
3. A.I. Vogel, Text book of quantitative inorganic analysis, V Edition, Longman , 1989.

CO – PO Mapping :

Inorganic Chemistry Practical - I **Code :23KP1CH03P**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	2	3	3	2	3	3	1	2
2	3	3	2	3	3	2	3	3	1	2
3	2	3	3	3	3	1	2	3	1	2
4	3	3	2	3	3	2	3	3	3	2
5	3	2	2	2	2	2	3	3	3	3

1 – Low, 2 – Moderate, 3 – High correlation

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SEM I	EC 1	ORGANIC CHEMISTRY PRACTICAL-I	23KP1CHECCH1P	Inst.Hr:5	Credit:3

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Separate the organic mixtures and identify the various functional groups through analysis.	K6
2	Demonstrate various reactions practically to prepare the organic compounds.	K3
3	Synthesis the organic compound by single stage.	K6
4	Imbibing the professional ethics in the synthesis of new compound.	K2
5	Separate the amino acids using paper chromatography	K4
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. Qualitative analysis of an Organic mixture containing two components. Pilot separation, bulk separation, analysis and derivatization.

2. Preparation of organic compound (single stage)
   a) Methyl-m-nitrobenzoate from methyl benzoate (nitration)
   b) Glucose pentaacetate from glucose (acetylation)
   c) Benzophenoneoxime from benzophenone (addition)
   d) O-chlorobenzoic acid from anthranilic acid (Sandmeyer Reaction)
   e) Phenylazo-2-naphthol from aniline (diazotisation)
   f)
3. Paper Chromatography- separation of amino acids (anthranilic acid and n-methyl anthranilic acid) and carbohydrates (glucose and fructose)

References

1. A.I. Vogel, Text book of practical organic analysis, V Edition, ELBS , London, 1989.

CO – PO Mapping :

Organic Chemistry Practical-I **Code :23KP1CHEC1P**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	3	3	3	1	3	3	1	1
2	2	3	3	3	3	1	3	3	1	2
3	3	3	3	3	3	2	3	3	1	2
4	3	3	3	3	3	2	3	3	2	3
5	2	3	3	3	3	2	2	3	1	2

1 – Low, 2 – Moderate, 3 – High correlation

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Title of the Course	**ELECTRO ANALYTICAL CHEMISTRY**						
Paper No.	**EC 2**						
Category	**Elective**	**Year**	I	**Credits**	3	**Course Code**	23KP1CHECCH2:1
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	4	1	-			5	
Prerequisites	Basic knowledge of Food chemistry						
Objectives of the course	Learn the principles of electrochemical methods such as steady state,potential step techniques and electrode and electrolyte interface. Explain the models of interface of double layer. Understand the applications of SECM,STM,AFM and AEM. Summarize the types of electrode reaction, charge transfer reaction and derive the Butler-Volmer equation. Analyse electrochemical reaction through voltammetry, amperometry and coulometry						
Course Outline	**UNIT I Introduction to Electrochemistry** Principles of electrochemical methods-Electrochemical reactions –steady state and potential step techniques. Superconducting magnets-thermodynamic and transport properties of aqueous and non-aqueous electrolyte-the electrode/electrolyte interface-and the kinetics of electrode processes.						
	UNIT II Models of Inerface Different models of double layer-Parallel plate model-Guay chapman model-Stern Helmholtz model-Electrical Double Layer mathematical description.Competition between water and organic molecules at the interface.						
	UNIT III Scanning Probe Techniques Introduction,Principles and Electrochemical applications:Scanning-ElectrochemicalMicroscope(SECM)-Scanning Tunneling Microscope(STM) Instrumentation and application:Atomic Force Microscope (AFM)-Atomic Electro Microscope(AEM).						
	UNIT IV Electrodics Introduction-types of electrodes reaction-various types of over potential-Exchange Current, Density-Derivation of Butler Volmer Equation-Over Potential relations at different condition.Charge transfer reactions-Determination and mechanism of kinetic parameters like exchange current,Tafelconstants,stoichiometric number and activation energy.						
	UNIT V Instrumental Technques In Electrochemistry Fundamentals of Electroanalytical methods-Voltammetry-Amperometry-Coulometry-Hydrodynamic voltammetry. Applications of Voltammetry-Anodic and Cathodic Stripping Voltammetry-Chronopotentiometry-Chronoamperometry-Pseudo Poloragraphy for specification studies.						
Reference Books	1. J.O.M .Bockris and A.K.N Reddy,Modern Electrochemistry –Vol I &II,A Plentium Edition,NewYork,1970. 2. D.A.Bonnell,ED.,"Scanning Tunneling Microscope and Spectroscopy-Theory,Techniques and Applications",VCH NewYork,1993. 3.Allen.J.Bard&Faulkner,Electrochemicalmethods,Fundamentals&Application,John Wiley & Sons,NewYork,1983. 4. R.Mukundan,Electrochemical Scanning probe microscopy,Washington,2007.						

	5. E.Gileadi,ElectrodeKinetics,VCH Publishers,Inc.NewYork,1993. 6. B.H.Vassons and G.W.Ewing,Electro Analytical Chemistry,John Wiley S sons,NewYork,1983.

CO – PO Mapping :

Electro Analytical Chemistry **Code :23KP1CHECCH2:1**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	2	3	1	2	3	3	2	3
2	3	3	2	3	1	2	3	3	2	3
3	3	3	3	3	3	3	3	3	2	3
4	3	3	2	3	3	1	3	3	2	1
5	3	3	3	3	3	3	3	3	2	3

1 – Low, 2 – Moderate, 3 – High correlation

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<table>
<tr><td>Title of the Course</td><td colspan="7">NANOMATERIALS AND NANOTECHNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">EC2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23KP1CHECCH2:2</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of crystallography and material science</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of nano materials and nano technology.
To understand the various types of nano materials and their properties.
To understand the applications of synthetically important nano materials.
To correlate the characteristics of various nano materials synthesized by new technologies.
To design synthetic routes for synthetically used new nano materials.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.</td></tr>
<tr><td colspan="7">UNIT-II: Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis-Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.</td></tr>
<tr><td colspan="7">UNIT-III: Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide andalumina - synthesisandproperties.</td></tr>
<tr><td colspan="7">UNIT-IV: Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.</td></tr>
<tr><td colspan="7">UNIT-V: Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core – shellnanoparticlestypes, synthesis andproperties.Nanocomposites – metal - ceramic-andpolymer – matrixcomposites-applications. Characterization– SEM, TEM and AFM - principle,instrumentationand applications.</td></tr>
<tr><td>Extended</td><td colspan="7">Questions related to the above topics, from various competitive</td></tr>
</table>

Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S.Mohanand V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzoet. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Reference Books	1. S.Mohanand V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzoet. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To explain methods of fabricating nanostructures.

CO2: To relate the unique properties of nanomaterials to reduce dimensionality of the material.

CO3: To describe tools for properties of nanostructures.

CO4: To discuss applications of nanomaterials.

CO5:To understand the health and safety related to nanomaterial.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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Title of the Course	ORGANIC CHEMISTRY-II						
Paper No.	**CC 4**						
Category	**Core**	**Year**	I	**Credits**	5	**Course Code**	**23KP2CH04**
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	**Basic knowledge of organic chemistry**						
Objectives of the course	To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds. To understand the mechanism involved in various types of organic reactions with evidences. To understand the applications of synthetically important reagents. To correlate the reactivity between aliphatic and aromatic compounds. To design synthetic routes for synthetically used organic reactions.						
Course Outline	**UNIT-I: Elimination and Free Radical Reactions:** Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.						
	UNIT-II: Oxidation and Reduction Reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide-dicyclohexylcarbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.						
	UNIT-III: Rearrangements: Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann						

	and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.
	UNIT-IV: Addition to Carbon Multiple Bonds: Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prinsreaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions.Hydrolysis of esters and amides, ammonolysis ofesters.
	UNIT-V: Reagents and Modern Synthetic Reactions: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammoniumtribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridiniumchlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex**.** Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons.2001. 2. E. S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959. 3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8th edn, New Age International Publishers,2015. 4. P. Y.Bruice, *Organic Chemistry*, 7th edn.,Prentice Hall, 2013. 5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7th edn., Pearson Education,2010.
Reference Books	1. S. H. Pine, *Organic Chemistry*, 5th edn, McGraw Hill International Editionn, 1987. 2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay,2000. 3. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959. 4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989. 5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4th ed., John-Wiley,2010.
Website and e-learning source	1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic principles of aromaticity of organic and heterocyclic compounds.
CO2: To understand the mechanism of various types of organic reactions.
CO3: To predict the suitable reagents for the conversion of selective organic compounds.
CO4: To correlate the principles of substitution, elimination, and addition reactions.
CO5:To design new routes to synthesis organic compounds.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

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Title of the Course	**PHYSICAL CHEMISTRY-I**						
Paper No.	**CC 5**						
Category	**Core**	**Year**	I	**Credits**	5	**Course Code**	23KP2CH05
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	**Basic concepts of physical chemistry**						
Objectives of the course	To recall the fundamentals of thermodynamics and the composition of partial molar quantities. To understand the classical and statistical approach of the functions To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein To correlate the theories of reaction rates for the evaluation of thermodynamic parameters. To study the mechanism and kinetics of reactions.						
Course Outline	**UNIT-I: Classical Thermodynamics:** Partial molar properties-Chemical potential, Gibb's- Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.						
	UNIT-II: Statistical thermodynamics: Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy and Gibb's function, equilibrium constants and equipartition principle. Heat capacity of solids-Einstein and Debye models.						
	UNIT-III: Irreversible Thermodynamics: Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.						
	UNIT-IV: Kinetics of Reactions: Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis-molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of						

	thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis-acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.
	UNIT-V: Kinetics of complex and fast reactions: Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 - Cl_2$& $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods - stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986. 2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. BenjaminPublishers, California, 1972. 3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995. 4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013. 5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,Macmillan India Ltd, Reprint - 2011.
Reference Books	1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999. 2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990. 3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974 4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996. 5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.
Website and e-learning source	1. https://nptel.ac.in/courses/104/103/104103112/ 2. https://bit.ly/3tL3GdN

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To explain the classical and statistical concepts of thermodynamics.
CO2: To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.
CO3: To discuss the various thermodynamic and kinetic determination.
CO4: To evaluate the thermodynamic methods for real gases ad mixtures.
CO5:To compare the theories of reactions rates and fast reactions.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

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SEM II	CC 6(P)	INORGANIC CHEMISTRY PRACTICAL - II	23KP2CH06P	Ins.Hrs.6	Credit:4

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Know the principles behind volumetric and gravimetric techniques.	K1
2	Separate the metal ions in binary mixtures.	K3
3	Estimate the metal ions.	K5
4	Comprehend the titration involving estimations of metals and hardness of water.	K2
5	Know the principles behind volumetric and gravimetric techniques.	K1
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. **Titrimetry and Gravimetry**

   Analysis of mixtures using volumetric and gravimetric methods.

   Cu (V) and Ni (G)
   Cu (V) and Zn (G)
   Fe (V) and Zn (G)
   Fe (V) and Ni (G)
   Zn (V) and Cu (G)

2. **Complexometric titrations involving estimations of Ca, Mg, Ni, Zn and hardness of water.**

3. **Preparation of the following complexes;**

   Tetramminecopper(II)sulphate
   Potassium trioxalatochromate(III)
   Potassium trioxalatoaluminate(III)
   Trithioureacopper(I) chloride
   Trithioureacopper(I) sulphate.

Reference:

1. Jeffery G.H, Bassett J, Mendham J and Danney R.C. Vogel, Text book of quantitative chemical analysis, 5th Ed., Longman Scientific and Technical Essex(1989).

CO – POMapping :

Inorganic Chemistry Practical-II **Code: 23KP2CH06P**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	3	3	3	2	3	3	2	3
2	3	3	3	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3
5	3	2	2	3	3	2	3	3	2	2

1 – Low, 2 – Moderate, 3 – High correlation

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SEM II	EC 3	ORGANIC CHEMISTRY PRACTICAL –II	23KP2CHECCH3P	Ins.Hrs.4	Credit:3

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Understand the Quantitative analysis in organic chemistry.	K2
2	Analyse the oils, saponification of iodine value of an oil.	K4
3	Know the protocol for the preparation of an organic compound by double stage.	K1
4	Understand the various types of reaction through the preparation of organic compounds.	K2
5	Estimate the phenol, aniline, ketone, glucose and nitrobenzene	K5
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. Quantitative Analysis of Organic Compounds.
Estimation of phenol, aniline, ketone, glucose, nitrobenzene.

2. Analysis of oils: Saponification and Iodine values of an oil.

3. Preparation of organic compounds (Double Stage)

a) p-bromo acetanilide from aniline (Acetylation and Bromination)
b) Acetyl salicylic acid from methyl salicylate (Hydrolysis and acetylation)
c) P-nitroaniline from acetanilide (nitration and hydrolysis)
d) Benzanilide from benzophenone (rearrangement)
e) P-amino benzoic acid from p-nitro toluene (oxidation and reduction)

References

1. N. S. Gnanaprakasam, G. Ramamurthy, Organic Chemistry manual,
S. Viswanathan Co. Ltd.,
2. Vogel text book of practical Organic Chemistry 5th edition, Prentice Hall, 2008.
3. Raj. K. Bansal, Laborratory manual of Organic Chemistry, 3rdEdn, New age international(P) Ltd., 1996.

CO – PO Mapping :

Organic Chemistry Practical –II **Code : 23KP2CHECCH3P**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	3	3	3	2	3	3	2	3
2	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	2	3	3	2	2
4	3	3	3	3	3	3	3	3	2	3
5	3	3	3	3	3	2	3	3	2	2

1 – Low, 2 – Moderate, 3 – High correlation

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

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<table>
<tr><td>Title of the Course</td><td colspan="7">POLYMER CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">EC 4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23KP2CHECCH4:1</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of general chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the basic concepts and bonding in polymers.
To explain various types of polymerization reactions and kinetics.
To understand the importance of industrial polymers and their synthetic uses.
To determine the molecular weight of polymers.
To predict the degradation of polymers and conductivities.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Characterization, Molecular weight and its Determination: Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests, thermal methods, Tg, molecular distribution, stability. Determination of Molecular mass of polymers: Number Average molecular mass (M_n) and Weight average molecular mass (M_w) of polymers. Molecular weight determination of high polymers by physical and methods.</td></tr>
<tr><td colspan="7">UNIT-II: Mechanism and kinetics of Polymerization: Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization. Reaction kinetics. Step growth polymerization, Degree of polymerization.</td></tr>
<tr><td colspan="7">UNIT-III: Techniques of Polymerization and Polymer Degradation: Bulk, Solution, Emulsion, Suspension, solid, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photo degradation, Photo stabilizers, Solid and gas phase polymerization.</td></tr>
<tr><td colspan="7">UNIT-IV: Industrial Polymers: Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde and expoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers: Elementary ideas; examples: poly sulphur nitriles, polyphenylene, poly pyrrole and polyacetylene. Polymethylmethacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols.</td></tr>
<tr><td colspan="7">UNIT-V:Polymer Processing: Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing. Film casting, Thermofoaming, Foaming. Catalysis and catalysts – Polymerization catalysis, catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium, heterogeneous catalysis and active centres.</td></tr>
<tr><td>Extended</td><td colspan="7">Questions related to the above topics, from various competitive</td></tr>
</table>

Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	**1.** V.R. Gowariker, *Polymer Science*, Wiley Eastern,1995. 2. G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited,1996. 3. M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand & Company, New Delhi, 2004.
Reference Books	1. F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience,1971. 2. A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill,1978.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To understand the bonding in polymers.
CO2: To scientifically plan and perform the various polymerization reactions.
CO3: To observe and record the processing of polymers.
CO4: To calculate the molecular weight by physical and chemical methods.
CO5: To interpret the experimental data scientifically to improve the quality of synthetic polymers.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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<table>
<tr><td>Title of the Course</td><td colspan="8">MEDICINAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">EC 4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">23KP2CHECCH4:2</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of medicinal chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To study the chemistry behind the development of pharmaceutical materials.
To gain knowledge on mechanism and action of drugs.
To understand the need of antibiotics and usage of drugs.
To familiarize with the mode of action of diabetic agents and treatment of diabetes.
To identify and apply the action of various antibiotics.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Introduction to receptors: Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.</td></tr>
<tr><td colspan="8">UNIT-II: Antibiotics: Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicllins and tetracyclins, clinical application of penicillins, cephalosporin.Current trends in antibiotic therapy.</td></tr>
<tr><td colspan="8">UNIT-III: Antihypertensive agents and diuretics: Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.</td></tr>
<tr><td colspan="8">UNIT-IV: Antihypertensive agents and diuretics: Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.</td></tr>
<tr><td colspan="8">UNIT-V: Analgesics, Antipyretics and Anti-inflammatory Drugs: Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, 2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011. 3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. JayashreeGhosh,AtextbookofPharmaceuticalChemistry,S.ChandandCo.Ltd,1999,1999 edn. 4. O.LeRoy,Natural andsyntheticorganicmedicinal compounds,Ealemi,1976. 5.S.AshutoshKar,MedicinalChemistry, WileyEasternLimited, NewDelhi,1993,New edn.
Reference Books	1. Foye'sPrincles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012 2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010. 3. WilsonandGisvold'sTextbookofOrganicMedicinalandPharmaceuticalChemistry,John M.BealeJrandJohnM. Block, Wolters Kluwer, 2011,12th edn. 4. P.Parimoo,ATextbookofMedicalChemistry,NewDelhi:CBSPublishers.1995. 5. S.Ramakrishnan, K.G.PrasannanandR.Rajan,TextbookofMedicalBiochemistry,Hyderabad: OrientLongman.3rd edition,2001.
Website and e-learning source	1. https://www.ncbi.nlm.nih.gov/books/NBK482447/ 2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html 3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Predict a drugs properties based on its structure.

CO2: Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design.

CO3: Explain the relationship between drug's chemical structure and its therapeutic properties.

CO4: Designed to give the knowledge of different theories of drug actions at molecular level.

CO5: To identify different targets for the development of new drugs for the treatment of infectious and GIT.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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Title of the Course	**PAINT CHEMISTRY**						
Paper No.	**SEC 1**						
Category	**Core**	**Year**	I	**Credits**	2	**Course Code**	**23KP2CHSEC1**
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	3	1	-			4	
Prerequisites	Basic knowledge of Paint chemistry						
Objectives of the course	To Know the paint content and the processes of paint production.						
Course Outline	**UNIT – I: Paint ingredients :**– Classification of paints – according to drying mechanism –under coats – Technical terms, Sag, Skin Irreversible gel, shelf life, Pot life, Solids,vehicle–consistencyofthixotrophy– Dryfilmproperties–Adhesion–gloss–flexibility–repair and renovation – Pigments – function (opacity, protective and Reinforcing) –classification – properties – optical – particle size and shape – refractive index – Tinting strength – Chemical reactivity – Bleeding characteristic Hiding power – Examples ofpigments–zincoxide–chromegreens– Lithophoneselectionofpigments–dispersioncolourmatching.						
	UNIT – II: Classification of solvents – facts and theory – solvent – properties – boiling point and evaporation rate – uses of solvents – toxicity. Paint additives wetting and dispersing agents. Anti setting – anti – sag and bodying agents – Aluminum soaps – hydrogenated castor oil, modified clays – anti skinning agents – examples – anti flood and anti-float additives- factors influencing flooding and floating – Mildew – inhibitors – dispersing agents (anionic) stabilizing agents (Non ionic) Anti foam agents – thickening agents –preservatives–freezer stabilizers.						
	UNIT – III: Fundamentals - Colloidal chemistry of coatings, surface chemistry of pigments, pigment dispersion and wetting, flushing of pigments, effect of pigment volume concentration on paint properties. Paint additives, solvents, basics of paint formulations, machinery for grinding of pigments and extenders.						
	UNIT – IV: Insulating and Intumescent Coatings - Preparation of different solvent & water based coatings, powder coatings, dry distempers, oil based distempers and paints, PU based clear coats/dispersions, washable distempers, application of these coatings, cement paints, other stiff paints, putties, manufacturing of alkyds, emulsions, paints, filtration of resins, ultra filtration of ED resins, forming of hard resins, various insulating resins and polymers used for heat and electrical insulations.						
	UNIT – V: AdvancedPaintsTechnology - Paint industry overview, problems and prospects, formulation of primers, zinc rich epoxy, micaceous ironoxide, zinc chromate and tetraoxy chromate, zinc phosphate based primers, wash primers, anti fouling coatings, paints for marine environments, vinyl paints, road marking paints, cement paints, automotive protection products, paints, finishing and refinishing, coatings for high						

	temperature, aerospace and aircrafts, insulating paints, UV- curable coatings, electro deposition coatings, metallic paints.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Paint and Surface Coatings by Lambourne and Strivens 2. Organic Coatings Science and Technology by ZenoWicksetal 3. Surface Coatings Science and Technology by Swaraj Paul 4. Introduction to Paint Chemistry by Turner
Reference Books	1. G.P.A.Turner–Principles of Paint Chemistry and Introduction to paintTechnology Oxford & IBH Publishing & Co 2. Paint Film Defects by HESS's 3. Modern technology of surface coating & Varnishes by SSP 4. Paint, Lacquers, Enamels, Powder coating &Varnishes by SSP consultancy

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<table>
<tr><td>Title of the Course</td><td colspan="7">FUEL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">ECC 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23KP2CHECC1:1</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Fuel chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">Compile the review of energy sources, classification and calorific value of fuels. Understand the analysis, composition, uses of coal and coal bar. Demonstrate the fractional distillation and uses of petro chemicals. Comprehends the alternative and renewable fuels like bio fuels (different generations) gaseous fuels (e.g CNG, LNG and LPG etc.,) Know the concept of lubricants and properties of lubricants.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT – I: Review of energy sources (Renewable and non Renewable) Classification of fuels and their calorific value. Determination of calorific value by Bomb calorimeter.Synthetic fuels from coal, Properties of Fuels and Characteristics of an ideal fuel.</td></tr>
<tr><td colspan="7">UNIT-II Coal: Analysis of coal, Proximate and ultimate Analysis. Uses of coal (fuel and nonfuel) in various industries,its composition, carbonization of coal, coal gas, producer gas and water gas – composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals.</td></tr>
<tr><td colspan="7">UNIT-III Petroleum and petrochemical industry: Composition of crude petroleum, Different types of petroleum products and their applications. Fuels derived from biomass – Production of fuels from Wood sources, crops, cereal crops and non -cereal crops.</td></tr>
<tr><td colspan="7">UNIT-IV Fractional distillation(Principle and process) : Cracking – Thermal and catalytic cracking ; Qualitative treatment of non- petroleum fuels – LPG, CNG, LNG, bio-gas , fuels derived from biogas ,fuel from waste, synthetic fuels- gaseous and liquids.Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives, Benzoic acid , Xylene.</td></tr>
<tr><td colspan="7">UNIT-V Lubricants: Classification of lubricants, lubricating oils(Conducting and non - conducting) Solid and semisolid lubricants ,Liquid lubricants , synthetic lubricants. Properties of lubricants – viscosity index,cloud point, pour point, Coke number ,Carbon residue and Decomposition stability.</td></tr>
<tr><td>Reference Books</td><td colspan="7">Ajayi.O.O., Erdimer, A.Fenske. Erck. R.A., Hsieh.J.H.,and Nichols F.A.,Effect of metalliccoating properties on the tribology of coated and oil=lubricated ceramics, Tribol. Trans., 1994,37,656-661.
Barnett.R.S., Molybdenum disulphide as an additive for lubricating greases, Lubr. Engg ., 1977,33,308-313.
E.Stocchi: Industrial chemistry, V0l- I, Ellis Horwood Ltd. UK.
P.C Jain, M.Jain: Engineering chemistry, DhanpatRai &Sons ,Delhi.
Sharma B.K &Gaur .H . Industrial chemistry,Goel Puplishing House, Meerat.</td></tr>
</table>

CO – PO Mapping :

Fuel Chemistry **Code :**23KP2CHECC1:1

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	2	3	2	3	3	3	3	3	2
2	3	3	3	2	3	3	3	3	3	3
3	3	3	3	2	3	3	3	3	3	2
4	3	3	3	2	3	3	3	3	3	3
5	3	3	3	2	3	2	3	3	3	3

1 – Low, 2 – Moderate, 3 – High correlation

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<table>
<tr><td>Title of the Course</td><td colspan="8">WATER QUALITY ANALYSIS</td></tr>
<tr><td>Paper No.</td><td colspan="8">ECC2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">23KP2CHECC2</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of Water Quality Analysis</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To objective the course is to give an in-depth understanding of water quality parameters, ground water and surface water pollution and its control measures. In addition, the students will also learn the water treatment methods, sewage and industrial effluent treatment methods and water resources management.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="8">UNIT – I: Water quality parameters and their determination: Physical, chemical and biological standards significance of these contaminants over the quality and their determinations – Electrical conductivity – turbidity – pH, total solids, TDS – alkalinity – hardness – chlorides –DO – BOD – COD – TOC – nitrate – sulphate, fluoride.</td></tr>
<tr><td colspan="8">UNIT – II: Ground water and surface water pollution and control measures: Surface water and Ground water pollution – Harmful effects – pollution of major rivers – protecting ground water from pollution - ground water pollution due to fluoride, Iron, Chromium and Arsenic – sources, its effects and treatment methods.</td></tr>
<tr><td colspan="8">UNIT – III: Water treatment methods: Treatment for community supply – screening, sedimentation, coagulation, filtration - removal of micro organisms – chlorination, adding bleaching powder, UV irradiation and ozonation.</td></tr>
<tr><td colspan="8">UNIT – IV: Sewage and industrial effluent treatment: Sewage - characteristics – purpose of sewage treatment – methods of sewage treatment- primary – secondary and tertiary – Role of algae in sewage treatment. Types of industrial wastes – treatment of effluents with organic and inorganic impurities.</td></tr>
<tr><td colspan="8">UNIT – V: Water Management: Water resources Management – rain water harvesting methods – percolation ponds – check dams – mof top collection methods – water management in industries.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired</td><td colspan="8">Knowledge, Problem solving, Analytical ability, Professional Competency,</td></tr>
</table>

from this course	Professional Communication and Transferable skills.
Reference Books	1. Chemical and biological methods for Water Pollution Studies, R.K. Trivedy and P.K. Goel, Environmental Publications, 1986. 2. Engineering Chemistry, P.C. Jain and Monica Jain, Dhanpat Rai and Sons, 1993. 3. Environmental chemistry, B.K. Sharma, Goel Publishing House. Water Quality and Defluoridation Techniques, Rajiv Gandhi National Drinking Water Mission Publication, 1994.

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<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC CHEMISTRY III</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 7</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23KP3CH07</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
To study various synthetically important reagents for any successful organic synthesis.
To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
To learn the concepts of pericyclic reaction mechanisms.
To gain the knowledge of photochemical organic reactions.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Planning an Organic Synthesis and Control elements: Preliminary Planning – knowns and unknowns of the synthetic system studied, analysis of the complex and interrelated carbon framework into simple rational precursors, retrosynthetic analysis, alternate synthetic routes, key intermediates that would be formed, available starting materials and resulting yield of alternative methods. Linear Vs convergent synthesis. synthesis based on umpolung concepts of Seebach, regiospecific control elements. Use of protective groups, activating groups and bridging elements. Examples on retrosynthetic approach, calculation of yield, advantages of convergent synthesis, synthesis of stereochemistry-controlled products.</td></tr>
<tr><td colspan="7">UNIT-II: Organic Synthetic Methodology: Retrosynthetic analysis; Alternate synthetic routes. Synthesis of organic mono and bifunctional compounds via disconnection approach. Key intermediates, available starting materials and resulting yields of alternative methods. Convergent and divergent synthesis, Synthesis based on umpolung concepts of Seebach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis. Control elements: Regiospecific control elements. Use of protective groups, activating groups, and bridging elements. Stereospecific control elements. Functional group alterations and transposition.</td></tr>
<tr><td colspan="7">UNIT-III: Pericyclic Reactions: Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams. Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions. ; Electrocyclization and ring opening reactions of conjugated dienes and trienes. Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions. Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions.</td></tr>
</table>

	UNIT-IV: Organic Photochemistry-I: Photochemical excitation: Experimental techniques; electronic transitions; Jablonskii diagrams; intersystem crossings; energy transfer processes; Stern Volmer equation. Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$ triplets; Norrish type-I and type-II cleavage reactions; photo reductions; Paterno-Buchi reactions;
	UNIT-V: Organic Photochemistry-I: Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationery state; di-π-methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reactions.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003. 2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007. 3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990. 4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016. 5. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.
Reference Books	1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974. 2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004. 3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007. 4. H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972. 5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.
Website and e-learning source	**1. https://rushim.ru/books/praktikum/Monson.pdf**

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms.

CO2: To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions.

CO3: To implement the synthetic strategies in the preparation of various organic compounds.

CO4: To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds.

CO5: To design and synthesize novel organic compounds with the methodologies learnt during the course.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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<table>
<tr><td>Title of the Course</td><td colspan="7">INORGANIC CHEMISTRY – II</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 8</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23KP3CH08</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To gain insights into the modern theories of bonding in coordination compounds.
To learn various methods to determine the stability constants of complexes.
To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
To evaluate the reactions of octahedral and square planar complexes.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Modern theories of coordination compounds: Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series - crystal field stabilisation energy for high spin and low spin complexes- evidences for crystal field splitting - site selections in spinels and antispinels - Jahn Teller distortions and its consequences. Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes.</td></tr>
<tr><td colspan="7">UNIT-II: Spectral characteristics of complexes: Term;P states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racha parameter and calculation of inter-electronic repulsion parameter.</td></tr>
<tr><td colspan="7">UNIT-III: Stability and Magnetic property of the complexes: Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum’s half method, Potentiometric method, Spectrophotometric method, Ion exchange method, Polorographic method and Continuous variation method (Job’s method) Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.</td></tr>
<tr><td colspan="7">UNIT-IV: Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and Labile complexes; Associative, Dissociative and SNCB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation</td></tr>
</table>

	Energy; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds.
	UNIT-V: Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and Marcus-Hush theory; inner sphere electron transfer reactions; nature of the bridging ligand in inner sphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976. 5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6thed.; Wiley Inter-science: New York, 1988.
Reference Books	1. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, Saunders Publications, USA, 1977. 2. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010. 3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn. 4. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. 5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.
Website and e-learning source	https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Understand and comprehend various theories of coordination compounds.

CO2: Understand the spectroscopic and magnetic properties of coordination complexes.

CO3: Explain the stability of complexes and various experimental methods to determine the stability of complexes.

CO4: Predict the electronic transitions in a complex based on correlation diagrams and UV-visible spectral details.

CO5: Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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<table>
<tr><td>Title of the Course</td><td colspan="7">SPECTROSCOPIC METHODS</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 9</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>23KP3CH09</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Spectroscopy</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">Understand the basic principle and transitions involved in UV IR and Raman spectroscopy. Acquire the keen knowledge from electronic spectroscopy and NMR spectroscopy. Know the basic principles of ESR and NQR, Illustrate the concept of Mass, Massbauer spectroscopy and the Combined spectroscopic problems</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I: Ultraviolet and Visible Spectroscopy: Introduction – Electronic Transitions and Selection rules- Orgin, General appearance and designation of UV bands- Absorption law- Measure of absorption intensity- Chromophores and Auxochromes- Various Shifts- Bathochromic shift, Hypsochromic shift, Hyperchromic effect, Hypochromic effect, Isosbestic point, Factors affecting the position of UV bands, Fischer – Woodward rules for Conjugated Dienes and Carbonyl Compounds, Ultraviolet Spectra of Aromatic and Heterocyclic Compounds. Steric effect in Biphenyls.

UNIT– II: Infrared spectroscopy: Selection rule-The diatomic vibrating rotator-- Harmonic and Anharmonic oscillator-.The interaction of rotations and vibrations-Vibrations of poly atomic molecules. Parallel and perpendicular bonds-Calculations of force constants, anharmonicity constants, Fermi resonance, dissociation energy and zero point energy-isotopic substitution.
Characteristic vibrational frequencies of Alkanes, Alkenes, Alkynes, Aromatic compounds, Alcohols, Esters, Phenol and Amines. Detailed study of vibrational frequencies of Carbonyl Compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones and conjugated carbonyl compounds). Effect of Hydrogen Bonding and Solvent Effect on Vibrational frequencies.
Raman spectroscopy: Selection rules-pure rotational Raman spectra-Vibrational Raman spectra- Raman Scattering-Comparison of IR and Raman spectra- Techniques and Instrumentations(principles only).Structural determinations of simple molecules.

UNIT – III: Proton Magnetic Resonance Spectroscopy.
General introduction to NMR- Correlation of Protons bonded to carbon (aliphatic and aromatic) and other nuclei (hydrocarbons, alcohols, phenols, carboxylic acids, amines, amides, carbonyl compounds and esters), Chemical exchange, Effect of Deuteration, Spin – Spin interaction including long range coupling (first order spectra), Virtual Coupling. Simplification of complex spectra - nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, Nuclear Overhauser Effect (NOE).
Carbon 13 - NMR Spectroscopy</td></tr>
</table>

	General considerations - Chemical Shift (aliphatic, olefinic, alkynes, aromatic, Hetero aromatic and carbonyl carbon), coupling constants. Two dimension NMR spectrometry – COSY, NOESY and DEPT techniques.
	UNIT – IV: ESR spectroscopy: Basic principles and features of ESR spectra – line shape and line widths-the g-value-spin densities and Mcconnel relationship – hyper fine splitting-origin of hyperfine interactions-ESR and molecular orbital theory –zero field splitting and krammer's degeneracy in ESR-applications of ESR to some simple systems. **NQR spectroscopy:** Characteristics of Quadrupolar nucleus – Effect of field gradient and magnetic field upon Quadrupolar energy levels, NQR Transition – Applications of NQR Spectroscopy.
	UNIT – V: Mass Spectroscopy: Introduction – Principles - molecular ion peak, metastable peak, Isotope Peaks, Mc Lafferty Rearrangement - Nitrogen Rule - Mass Spectral fragmentation of Organic Compounds with respect to their structural determination. Massbauer Spectroscopy- Basic principles- Spectral parameters, Spectrum display and isomer shift Application of the technique to the studies of 1. Bonding and structure of Fe^{+2} and Fe^{+3}componds including those of Intermediate spin 2. Sn^{+2} and Sn^{+4} compounds- nature of M-L bond, Co-ordination number, structure combined spectroscopy problems.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Reference Books	1. C.N.Banwell. Fundamentals of molecular spectroscopy,,Tata McGraw Hill . 2. R.S.Drago, Physical methods for chemistry. Saunders Company 3. G.Bartow , "Introduction to molecular spectroscopy", McGraw-Hill . 4. P.K.Ghosh,"Introduction to Photo electron spectroscopy" John Wiley. 5. R.Chang, "Basic Principles of Spectroscopy",McGraw Hills. 6. .J.M.Hollas, "Modern Spectroscopy",John Wiley. 7. J.R.Dyer, "Applications of Spectroscopy of Organic compounds",Prentice Hall.

	8. Y.R.Sharma, "Elementary Organic Spetroscopy,Principle and applications",S.chand and Company Ltd. 9. Jag Mohan, Organic spectroscopy Principles and Applications, Narosa Publishing House, IIndedition, 2004.

CO – PO Mapping:

Spectroscopic Methods **Code: 23KP3CH09**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	2	3	3	3	3	3	2	2
2	3	3	2	3	3	2	3	3	2	3
3	3	3	3	3	3	2	3	3	2	3
4	3	3	3	3	3	2	3	3	2	3
5	3	3	2	3	3	3	3	3	2	3

1 – Low, 2 – Moderate, 3 – High correlation

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SEM III	CC 10 (P)	PHYSICAL CHEMISTRY PRACTICAL – I	23KP3CH10P	Ins.Hrs.-6	Credit:4

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Explain the principle behind the experiments and interpret the experimental results.	K2
2	Study the kinetics of the chemical reaction.	K5
3	Learn the concept of polarimeter.	K1
4	Understand the principles and applications of adsorption	K2
5	Estimate the molecular weight of additional solute by rast and thermometric method.	K6
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. Comparison of strength of acids 'A' and 'B' by determining rate constants of hydrolysis of an ester.
2. Determination of energy of activation frequency factor and temperature coefficient.
3. Determination of velocity constant and order ofof the reaction between potassium persulphate and potassium iodide.
4. A study of Primary salt effect.
5. A study of adsorption of oxalic acid on charcoal.
6. Effect of impurity on C.S.T of phenol-water system
7. Determination of transition temperature of the hydrated salt.
8. Determination of the molecular weight of given solute by the depression of freezing point method (Rast method).
9. Phase diagram for two components with simple eutectic system.
10. Determination of rate constant of inversion of sucrose by polarimeter and verification of the effect of catalyst on the rate constant.
11. Construction of phase diagram of a three component system containing ethanol,benzene and water.
12. Determination of equilibrium constant for the reaction between KI and I_2.
13. Determination activity coefficient of electrolyte.
14. Studies on the kinetics saponification of ethyl acetate by NaOH.
15. Iodination of acetone for determining order of reaction.

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<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY OF BIOMOLECULES</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 8</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23KP3CHECCH5:1</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Biomolecules.</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">After successful completion of the course, the students will be able to,
Explain the classification biomolecules and infer the standard free energy change in biochemical reaction. Analyse the role of metals in biological process. Interpret the functions of bioorganic molecules. Demonstrate the hydrolysis of ATP, photosynthesis and respiratory chain. Compare the dialysis, gelfiltration, chromatography, electrophoresis and ultra centrification DNA finger printing.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT – I:BASIC PRINCIPLES Classification of biometals-Essential, Trace and Ultra Trace Metals-Classes of Biomolecules and their Building Block Molecules. The first and second law of Thermodynamics-Standard Free Energy change in Biomolecules Reaction.</td></tr>
<tr><td colspan="7">UNIT – II:ROLE OF METALS IN BIOLOGICAL PROCESS Na+/K+ pump and Ca2+ pump Transport and storage of Iron-Transferrin and Ferritin Metal ion toxicity and Detoxification by Chelation Metallo therapy -Metal deficiency and its therapy and limitation.</td></tr>
<tr><td colspan="7">UNIT – III:BIO ORGANIC MOLECULES
Heamoglobin as an oxygen carrier-sickle cell anemia. Enzymes and Co-enzymes-classification-Factor X Hemophilia Lipids-Role of LDL-Hypercholesterolemia .Nucleosides and Nucleotides-Nomenclature and Structure –Degradation of Pyridines –Lesch – Nyhan Syndrome.</td></tr>
<tr><td colspan="7">UNIT – IV:BIO ENERGIETIES
Hydrolysis of ATP –Mechanical work of Muscular Contraction-Active Transport Across Membranes-Mechanism of photosynthesis-Light reaction and Dark reaction.Election Transport System –Respiratory Chain.</td></tr>
<tr><td colspan="7">UNIT – V:BASIC TECHNIQUES USED BIO SEPARATION
Dialysis,Gelfiltration,Chromatography,Electrophoresis,Ultracentrification DNA and Fingerprinting.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
</table>

course	
Recommended Text	1. Biochemistry,LubertStryer,CBS Publishers and Distribuers. **2** .Principles of Biochemistry,Lehninger,CBS Publishers and Distributers. **3.** .Metals in Biochemistry,P.M.Harrision and R.J.Hoarse,Chapman and Hoare,Chapam and Hall Ltd. **4**. Bio inorganic Chemistry,A.K.Das,CBS Publishers and Distributers.
Reference Books	**1.** .Practical Biochemistry,David.T.Plummer,TataMegraw-Hill Publishers Ltd **2.** .Essentials of Bio Organic Chemistry,R.W.Hanson,Edward Arnold Publishers Ltd **3.** Bio Inorganic Chemistry,M.Satake and Y.Mido,Discovery Publishing House **4.** Bio Inorganic Chemistry,G.R.Chatwal and A.K.Bhagi,Himalaya Publishing House

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:
CO1: Understand the classification biomolecules
CO2: Understand the biochemical reaction.
CO3: Understand the role of metals in biological process.Interpret the functions of bioorganic molecules.
CO4: Understand the hydrolysis of ATP,photosynthesis and respiratory chain.Compare the dialysis,gelfiltration,chromatography,electrophoresis and ultra centrification.
CO5: Understand DNA finger printing.

CO – PO Mapping :
Chemistry of Biomolecules **Code:23KP3CHECCH5:1**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	1	3	2	1	3	3	1	2
2	3	3	3	3	2	3	3	3	2	3
3	3	3	3	3	2	3	3	3	2	2
4	3	3	3	3	2	3	3	3	2	2
5	3	3	3	3	2	3	3	3	2	2

1 – Low, 2 – Moderate, 3 – High correlation

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<table>
<tr><td>Title of the Course</td><td colspan="7">MOLECULAR MODELLING AND DRUG DESIGN</td></tr>
<tr><td>Paper No.</td><td colspan="7">EC 5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23KP3CHECCH5:2</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Molecular modelling and drug design.</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">After successful completion of the course, the students will be able to, Know the basics in Molecular Modeling of compounds. Learn energy minimization methods through use of different forces fields. Learn ESP plots by suitable software, Electron rich and electron deficiency sites. Carry out Molecular dynamics(MD)and Simulation on several molecules and polymers. Explain the Hukel Molecular orbitals and PPP methods.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT- I : Molecular Modeling Basics
Molecular Modeling- coordinates systems- Cartesian and internal coordinates systems-bond lengths-bond angles and torsion angles-distance matrix-stick models- space filling models-Potential energy surfaces-Molecular Mechanics- application and parameterization-advantages and limitations CA force fields.</td></tr>
<tr><td colspan="7">UNIT – II: Potential Energy Surfaces: Intrinsic Reaction Coordinates, Stationary points-Local and global minima, concept of transition state with examples: Ethane, propane, butane, cyclohexane, Meaning of rigid and relaxed PES.
Applications of computational chemistry to determine reaction mechanisms.
Energy Minimization and Transition State Search: Geometry optimization, Methods of energy minimization: Multivariate Grid Search, Steepest Descent Method, Newton-Raphson method and Hessian matrix.</td></tr>
<tr><td colspan="7">UNIT – III: Molecular Mechanics: Force Fields, Non-bonded interactions(Vander waals and electrostatic), How to handle torsions of flexible molecules, Vander waals interactions using Lennard-Jones potential, Hydrogen bonding interaction, Electrostatic term, Parameterization. Application of MM, Disadvantages and Software.</td></tr>
<tr><td colspan="7">UNIT – IV: Molecular Dynamics: Radial distribution function for solids,Liquids and gases, Intermolecular potential(Hard Sphere, Finite square well and Lennard-Jones potential),Concepts of periodic box, Ensembles(Micro canonical, canonical, Isothermal-Isobaric), Ergodic Hypothesis. Integration of newton’s equations (Leapfrog and Verlet algorithms), Rescaling, simulation of pure water- Radial distribution curves and interpretation.</td></tr>
<tr><td colspan="7">UNIT –V: Hukel MO with Examples: Ethane, Propenyl, cyclopropenpyl systems, Properties calculated-Energy, Charges, Dipole moment, Bond order, Electronic energies, Resonance energies, Oxidation and Reduction(Cationic and anionic species of above systems). Extension to Extended Hukel theory and PPP methods.</td></tr>
<tr><td>Extended Professional</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to</td></tr>
</table>

Component (is a part of internal component only, Not to be included in the external examination question paper)	be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Reference Books	1. A.R.Leach,"Molecular modeling principles and applications", 2nd Edition, Prentice Hall,2001. 2. Lewars,E." Computational Chemistry",Kluwer academic publisher,2003. 3. Cramer,C.J" Essentials of computational Chemistry",John Wiley and sons,2004. 4. Hinchcliffe,A"Modeling Molecular Structures" John Wiley and sons,1996.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Understand the basics in Molecular Modeling of compounds

CO2: Understand energy minimization methods through use of different forces fields.

CO3: Understand the ESP plots by suitable software, Electron rich and electron deficiency sites.

CO4: Understand Molecular dynamics(MD) and Simulation on several molecules and polymers.

CO5: Understand the Hukel Molecular orbitals and PPP methods.

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CO – PO Mapping :

Molecular Modelling And Drug Design **Code:23KP3CHECCH5:2**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	2	2	3	2	3	3	3	2	3
2	2	2	2	2	1	1	2	3	1	1
3	3	2	2	3	2	1	3	3	1	1
4	3	3	1	3	3	1	3	3	1	3
5	3	2	1	3	3	3	3	3	1	1

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Arts College for Women (Autonomous),
THANJAVUR - 613 007, TN.

1 – Low, 2 – Moderate, 3 – High correlation

<table>
<tr><td>Title of the Course</td><td colspan="7">INDUSTRIAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23KP3CHSEC2</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Industrial Chemistry.</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">After successful completion of the course, the students will be able to, Know the different toxic gases and their toxicity hazards, safe design systems for large scale production of industrial gases. Analyse the manufacturing process handling and storage of inorganic chemicals. Comprehends the basic metallurgical operations such as pulverization,calcination, roasting and refining of metal and it alloys. Examine the composition of air, various air pollutants, effects and control measures of air pollutants. Discuss about the different sources of water, water quality parameters, impacts of water pollution water treatment and different industrial effluents and their treatment methods.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I Industrial gases
Large scale production, uses ,storage and hazards safe handling of the following gases: Oxygen, Nitrogen, Argon, Neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine and Sulphur dioxide</td></tr>
<tr><td></td><td colspan="7">UNIT II Inorganic Chemicals
Manufacture, applications, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, borax, bleaching powder, sodium thiosulfate, hydrogen peroxide, potassium dichromate and potassium permanganate</td></tr>
<tr><td></td><td colspan="7">UNIT III
Basic Metallurgical Operations: pulverization, calcination,roasting, refining of metals.Metals and Alloys.Important metals and alloys, iron, copper, aluminium, lead, Nickel, Titanium and their alloys-mechanical and chemical properties and their applications.</td></tr>
<tr><td></td><td colspan="7">UNIT IV Environment and its segments
Air pollutants:types, sources, particle size and chemical nature; photochemical smog: its constituents and photochemistry. Major sources of air pollution, Pollution by SO_2, CO_2, CO, NOx, H_2S and other foul smelling gases, methods of estimation of CO, NOx, SOx and control procedures, Effects of air pollution on living organisms and vegetation.
Greenhouse effect and global warming, Environmental effects of ozone, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, Air Pollution Control.</td></tr>
<tr><td></td><td colspan="7">UNIT V
Water Pollution: hydrological cycle ,water</td></tr>
</table>

	resources,aquaticecosystems.Sources and nature of water pollutants.Techniques for measuring water pollution, impacts of water pollution on hydrological cycle and ecosystem.Effluent treatment plants (primary secondary and tertiary treatment) Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, diary, Petroleum and petrochemicals, Agro fertilizer . Water purification methods: reverse osmosis, electrodialysis, Ion exchange.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Reference Books	1. Manahan, S.E. (2017), Environmental Chemistry, CRC Press. 2. Buchel, K.H. Moretto, H.H.Woditsch, P.(2003), Industrial Inorganic Chemistry, Willey – VCh. 3. De, A.K.(2012), Environmental Chemistry, New Age International Pvt., Ltd. 4. Khopkar, S.M.(2010), Environmental Pollution Analysis, New Age International Publisher.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Understand the different toxic gases and their toxicity hazards, safe design systems for large scale production of industrial gases.

CO2: Understand the manufacturing process handling and storage of inorganic chemicals.

CO3: Understand . the basic metallurgical operations such as pulverization, calcination, roasting and refining of metal and it alloys

CO4: Understand Examine the composition of air, various air pollutants, effects and control measures of air pollutants.

CO5: Understand the different sources of water, water quality parameters, impacts of water pollution water treatment and different industrial effluents and their treatment methods.

CO – PO Mapping :

Industrial Chemistry **Code:23KP3CHSEC2**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	2	2	3	2	3	3	3	2	3
2	2	2	2	2	1	1	2	3	1	1
3	3	2	2	3	2	1	3	3	1	1
4	3	3	1	3	3	1	3	3	1	3
5	3	2	1	3	3	3	3	3	1	1

1 – Low, 2 – Moderate, 3 – High correlation

23-8-2023

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Title of the Course	**DYE CHEMISTRY**						
Paper No.	**ECC 3**						
Category	**Core**	**Year**	II	**Credits**	3	**Course Code**	23KP3CHECC3:1
		Semester	III				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	-	-			-	
Prerequisites	Basic knowledge of Dye chemistry						
Objectives of the course	Tostrengthentheknowledgeaboutthemainpurposeofdyeingandhowfabricsaredyedinindustry. Toenablethelearningaboutthedyeingistheapplicationofdyesorpigmentsontextilematerials. Toknowaboutdyesmayrequireamordanttoimprovethefastnessofthedyeonthefiber. Tounderstandthatpretreatmentisaheartofprocessingoftextile.						
Course Outline	**UNIT – I:**Colourandconstitutions,Definition-Dye,chromophore,auxochrome,bathochromiceffectandhypsochromiceffect–Quinoid theory.Classification-acid,base,azo,vatandreactivedyes.AnthroquinoneandMordantDyes-synthesis andapplicationsof Alizarin.						
	UNIT – II: DiphenylmethaneDyes-synthesisandapplicationofAuramine-TriphenylmethaneDyes-MalachiteGreen,CrystalViolet,Pararosaniline – Preparation andapplications.IndigoDyes-PreparationandapplicationofIndigo.DerivativesofIndigo-SynthesisandusesofIndigosoland tetrabromoindigo-(Ciba blue).						
	UNIT – III: PhthaleinDyes–Phenolphthalein – preparationandapplications.XantheinDyes–RhodamineB, Fluorescein– Preparationand applications.Acridinedyes-synthesisandapplicationofAcriflavinandproflavin.Reactivedyes – synthesisandapplications of ProcionBlueHB.						
	UNIT – IV: Pigments - Requirementsoforganicpigments-Typesofpigments-Applications.Fluorescent,Brighteningagents.Applicationsofdyesinotherareas-medicine,chemicalanalysis, cosmetics,colouringagents.						
	UNIT – V: TextileEffluent-Characteristics,effectofuntreatedeffluent,degradabilityofwastes. Effluenttreatmentplants-Aeratedlagoon,photooxidationprocess.						
Reference Books	1. B.K.Sharma,IndustrialChemistry,GoelPublishingco,1997 2. GurdeepR.Chatwal,SyntheticDyes-Himalayan PublishingHouse,1995 3. R.S.Prayag,Dyeingofwool,Silkandmanmadefibres. 4. V.A.Shenai,ChemistryofDyesandPrinciplesof Dyeing. 5. K.Venkataraman, TheChemistryof synthetic dyes.						

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 11</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>23KP4CH11</td></tr>
<tr><td></td><td></td><td>Semester</td><td>IV</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>4</td><td>1</td><td colspan="3">-</td><td>6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the essential characteristics of wave functions and need for the quantum mechanics.
To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
To apply the quantum mechanics to hydrogen and polyelectronic systems.
To familiarize the symmetry in molecules and predict the point groups.
To predict the vibrational modes, hybridization using he concepts of group theory.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Wave particle duality, Uncertainty principle, Particle wave and Schrodinger wave equation, wave function, properties of wave function. Properties of wave function, Normalized, Orthogonal, orthonormal, Eigen values, Eigen functions, Hermitian properties of operators. Introduction to quantum mechanics-black body radiation, photoelectric effect, hydrogen spectrum. Need for quantum mechanics, Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Quantum models: Particle in a box-1D, two dimensional and three-dimensional, degeneracy, application to linear conjugated molecular system, free particles, ring systems. Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance. Rigid Rotor-wave equation and solution, calculation of rotational constants and bond length of diatomic molecules.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Applications to Hydrogen and Poly electron atoms: Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions. Approximation methods –variation methods: trial wave function, variation integral and application to particle in 1D box. Perturbation method - first order applications. Hatrefock self-consistent field method, Hohenberg-Kohn theorem and Kohn-Sham equation, Helium atom-electron spin, paulis exclusion principle and Slater determination.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Group theory: Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Dihedral point groups- C_n,C_{nh}, D_n, D_{nh}, D_{nd}, Td and Oh. Matrix representation and classes of symmetry operations, reducible irreducible and direct product representation. The Great orthogonality theorem – irreducible representation and reduction formula, construction of character table for C_{2v}, C_{2h}, C_{3v} and D_{2h} point groups.</td></tr>
</table>

	UNIT-V: Applications of quantum and group theory: Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment, Energy level diagram, Hydrogen molecule ion; Use of linear variation function and LCAO methods. Electronic conjugated system:Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene. Applications of group theory to molecular vibrations, electronic spectra of ethylene.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition. 2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition. 3. A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition. 4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition. 5. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.
Reference Books	1. N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition. 2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012. 3. R. P. Rastogi& V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 1999. 4. R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980 5. J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint.

Website and e-learning source	1. https://nptel.ac.in/courses/104101124 2. https://ipc.iisc.ac.in/~kls/teaching.html

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To discuss the characteristics of wave functions and symmetry functions.

CO2: To classify the symmetry operation and wave equations.

CO3: To apply the concept of quantum mechanics and group theory to predict the electronic structure.

CO4: To specify the appropriate irreducible representations for theoretical applications.

CO5: To develop skills in evaluating the energies of molecular spectra.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

23.8.2023

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<table>
<tr><td>Title of the Course</td><td colspan="7">INORGANIC CHEMISTRY –III</td></tr>
<tr><td>Paper No.</td><td colspan="7">CC 12</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>23KP4CH12</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To recognize the fundamental concepts and structural aspects of organometallic compounds.
To learn reactions of organometallic compounds and their catalytic behaviour.
To identify or predict the structure of coordination compounds using spectroscopic tools.
To understand the structure and bonding in coordination complexes.
To evaluate the spectral characteristics of selected complexes.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Chemistry of organometallic compounds: Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes (example: Ziese’s salt), metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters – Structures based on polyhedral skeleton electron pair theory or Wade’s rule.</td></tr>
<tr><td colspan="7">UNIT-II: Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction.Organo-metallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.</td></tr>
<tr><td colspan="7">UNIT-III: Inorganic spectroscopy -I: IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy-Introduction, applications of 1H, 15N, 19F, 31P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.</td></tr>
<tr><td colspan="7">UNIT-IV: Inorganic spectroscopy-II: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons –ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis (salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$. Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of</td></tr>
</table>

	Mössbauer spectra to Fe and Sn compounds.
	UNIT-V: Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations.Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University Press, 2013. 5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6thed.; Wiley Inter-science: New York, 1988.
Reference Books	1. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000. 2. P Gütlich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st edition, Springer-Verlag Berlin Heidelberg, 2011. 3. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. 4. K. F. Purcell, J. C. Kotz, Inorganic Chemistry; Saunders: Philadelphia, 1976. 5. R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977.

Website and e-learning source	https://archive.nptel.ac.in/courses/104/101/104101100/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: Understand and apply 18 and 16 electron rule for organometallic compounds
CO2: Understand the structure and bonding in olefin, allyl, cyclopentadienyl and carbonyl containing organometallic compounds
CO3: Understand the reactions of organometallic compounds and apply them in CO4: understanding the catalytic cycles
CO5: Identify / predict the structure of coordination complexes using spectroscopic tools such as IR, NMR, ESR, Mossbauer and optical rotatory dispersion studies to interpret the structure of molecules by various spectral techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

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SEM IV	EC 6 (P)	PHYSICAL CHEMISTRY PRACTICAL II RELATED TO INDUSTRY	23KP4CHECH6P	Ins.Hrs.4	Credit:3

CO	STATEMENT	
	After successful completion of the course, the students will be able to	
1	Discover the equivalent conductometric by DHO and Kohlrauch's law method and Dissociation constant by Ostwald's dilution method.	K3
2	Understand the concepts of various conductometric and potentiometric method.	K2
3	Evaluate the solubility product of AgCl by potentiometric and conductometric method.	K5
4	Determine the P^H of the buffer solutions.	K5
5	Analyse the strength of acids from its mixture by conductometric and potentiometric method.	K4
K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyse; **K5**-Evaluate **K6**-Create		

1. Verification of Onsagar's equation and determination of equivalent conductance at infinite dilution of strong electrolyte.
2. Verification of Ostwald's dilution law and determination of dissociation constant of weak acid.
3. Determination of equivalent conductance of a weak electrolyte by kohlrauch's law.
4. Determination of solubility product and solubility of silver chloride by conductance measurements.
5. ConductometricTitrations:mixture of acids Vs strong base
6. ConductometricTitrations:mixture of HCl and $CuSO_4$VsNaOH.
7. Conductometric Titrations: mixture of halide Vs $AgNO_3$
8. Conductometric Titrations:K_2SO_4,$MgSO_4$Vs $BaCl_2$
9. Determination of solubility and solubility product of silver chloride by Emf measurements.
   Determination of P^H of given buffer solution.
10. Estimation of ferrous ion using $K_2Cr_2O_7$
11. Estimation of ferrous ion using $KMnO_4$
12. Determination of dissociation constant of the organic acid using Quinhydrone electrode by potentiometry titration.
13. Potentiometric acid-base titration.
14. Determination of Hydrolysis constant of Aniline Hydrochloride.

CO – PO Mapping :

Physical Chemistry Practical-II **Code: 22KP4CHEC6P**

CO	PO									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	2	3	2	3	3	3	2	2
2	3	3	2	3	2	3	3	3	2	3
3	3	3	2	3	2	3	3	3	2	3
4	3	3	2	3	2	3	3	3	2	3
5	3	3	2	3	2	3	3	3	2	3

1 – Low, 2 – Moderate, 3 – High correlation

CONTROLLER OF EXAMINATIONS
25 AUG 2023
H.H.Govt. Arts College for Women (Autonomous), Thanjavur

25-8-2023
HOD of Chemistry,
Kunthavai Naachiyaar Government
Arts College for Women (Autonomous),
THANJAVUR - 613 007, TN.

<table>
<tr><td>Title of the Course</td><td colspan="7">RESEARCH METHODOLOGY FOR CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">SEC 3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23KP4CHSEC3</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of Research Methodology</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">By the end of the course, the students will be able to
1. Define the research, research problem and types of research.
2. Know by various types of sampling techniques.
3. Learn the literature survey of research in various components.
4. Know the methods to write research procedure for manuscripts, thesis, project work and oral presentation.
5. To understand in handling the chemicals, apparatus and safety procedure in lab</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I: Research – Meaning of research – types of research – Basic research, Applied research, Fundamental research, social research, action research – research description – hypothesis – types of hypothesis – Identification of a research problem. – Definition and formulation of a problem</td></tr>
<tr><td></td><td colspan="7">UNIT-II:Selection of the research problem-Sampling techniques – random sampling-data collection, processing and analysis of data, thesis writing – bibliography - preparation of manuscripts-full paper,preparation of seminar paper for oral presentation,short communications-review paper, use of computer browsing for literature search and downloading-basics of Internet services-various sources of abstracts,articles and papers for browsing and downloading.</td></tr>
<tr><td></td><td colspan="7">UNIT-III:Literature Survey - Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations; abstracts, current titles, reviews, monographs, dictionaries, text books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject index, Author index, Formula index and other indices with examples.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Methods of Scientific Research and Writing Scientific Papers Reporting practical and project work, idea about public funding agencies of research, Writing literature surveys and reviews. Organizing a poster display Giving an oral presentation, Writing scientific papers – justification for scientific contributions, bibiliography, description of methods, conclusions, the need for illustration, style, publications of scientific work, Writing ethics. Avoiding plagiarism.</td></tr>
<tr><td></td><td colspan="7">UNIT-V: Chemical safety and Ethical Handling of Chemicals
Safe working procedure and protective environment, protective apparel emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric level. Safe storage and disposal of waste chemicals. Recovery recycling and reuse of laboratory chemicals. Procedures for laboratory disposal of explosives . Identification,</td></tr>
</table>

	verification and segregation of laboratory waste. Disposal of chemicals in the sanitary sewer system. Incineration and transportation of hazardous chemicals.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	V.R. Gowariker, *Polymer Science*, Wiley Eastern,1995. G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited,1996. M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand& Company, New Delhi, 2004.
Reference Books	1. F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience,1971. 2. A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill,1978.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To understand the bonding in polymers.
CO2: To scientifically plan and perform the various polymerization reactions.
CO3: To observe and record the processing of polymers.
CO4: To calculate the molecular weight by physical and chemical methods.
CO5: To interpret the experimental data scientifically to improve the quality of synthetic polymers.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

23.8.2023

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