

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS) KUMBAKONAM

(Curriculum – M.Sc., Chemistry – 2024 – 2025 onwards)

Department : Chemistry

Programme Code: PSCH

SEMESTER – I

Part	Course type	Course Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
							CIA	ESE	Total
I	CC- I	P23CHC101	Organic Reaction Mechanism-I	6	5	3	25	75	100
	CC – II	P23CHC102	Structure and Bonding in Inorganic Compounds	6	5	3	25	75	100
	CC – III	P23CHC103P	Organic Chemistry -Practical	6	3	3	40	60	100
	EC - I	P23CHDE1 (Choice-I)	Electro Chemistry ✓	5	4	3	25	75	100
		P23CHDE2 (Choice-II)	Polymer Chemistry						
	EC - II	P23CHDE3 (Choice-I)	Estimation of Mixture of Metal Ions-Practical ✓	5	3	3	40	60	100
		P23CHDE4 (Choice-II)	Textile Chemistry-Practical						
	SEC- I	P23CH1SE1	Cosmetic Chemistry	2	2	3	25	75	100
Total				30	22				600

SEMESTER – II

	Course type	Course Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks		
							CIA	ESE	Total
I	CC- IV	P23CHC204	Organic Reaction Mechanism - II	6	5	3	25	75	100
	CC – V	P23CHC205	Physical Chemistry –I	6	5	3	25	75	100
	CC – VI	P23CHC206	Inorganic Chemistry -Practical	6	4	3	40	60	100
	EC - III	P23CHDE5 (Choice-I)	Green Chemistry ✓	5	4	3	25	75	100
		P23CHDE6 (Choice-II)	Medicinal Chemistry						
	EC - IV	P23CHDE7	Estimation of Organic Compounds-Practical ✓	5	2	3	40	60	100
		P23CHDE8	Qualitative and Quantitative Analysis of Phytochemicals-Practical						
	SEC- II	P23CH2SE2	Basic Clinical Chemistry	2	2	3	25	75	100
I	ECC-I	Ex-1	MOOCs/ Swayam courses		2/3				
			Internship / Industrial training*	--	--	--	--	--	--
Total				30	22				600

Internship/ Industrial training during summer vacation. The credits shall be awarded in semester III statement of marks

SEMESTER – III

Part	Course type	Course Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks	
							CIA	ESE
Part-I	CC- VII		Organic synthesis and photochemistry					
	CC –VIII		Physical Chemistry - II	6	6.5	3	25	75
	CC – IX		Industrial Chemistry	6	5	3	25	75
	CC - X		Physical Chemistry- Practical	6	5	3	25	75
	EC - V		1. Biomolecules and Heterocyclic Compounds ✓ 2. Pharmacognosy and Phyto chemistry	6	3.4	6	40	60
Part II	IDSEC 3		Food and Nutrition	4	3	3	25	75
	ECC- II Ex2		MOOCS /Swayam courses	2	2	3	25	75
	ECC- III Ex3		General studies for Research Fellowship & Lectureship	-	2/3	-	-	-
	AEC -I 4		Internship / Industrial training		2	3		
Total				30	26			

SEMESTER – IV

Part	Course type	Course Code	Title of the Course	Hrs/ Week	Credits	Exam Hrs	Marks	
							CIA	ESE
Part-I	CC- XI		Coordination chemistry					
	CC – XII		Analytical Instrumentation Techniques- Practical	6	6	3	25	75
	CC – XIII		Project with Viva Voce	6	3.4	3	40	60
	EC – VI 5		Industry / entrepreneurship based 20% theory 80% practical	8	5	-	-	-
	AEC II 6		1. Soil Analysis -Practical 2. Water Analysis –Practical ✓	5	4.3	3	40	60
Part II	EA		Chemistry For Competitive Examinations	5	2	3	25	75
			Extension Activity	-	2	-	-	-
Total				30	22			

Elective courses offered by the Department of Chemistry
2024 – 2025 onwards

S.no	Title of the Paper	Credits
1.	Electrochemistry	4
	Polymer chemistry	4
2.	Estimation of Mixture of Metal Ions-Practical	3
	Textile Chemistry -Practical	3
3.	Green Chemistry	4
	Medicinal Chemistry	4
4.	Estimation of Organic Compounds-Practical	3
	Qualitative and Quantitative Analysis of Phytochemicals-Practical	3
5.	Biomolecules and Heterocyclic Compounds	3
	Pharmacognosy and Phyto Chemistry	3
6.	Industry / entrepreneurship based 20% theory 80% practical 1. Soil Analysis -Practical 2. Water Analysis -Practical	4

GOVERNMENT COLLEGE FOR WOMEN (AUTONOMOUS)

KUMBAKONAM

DEPARTMENT OF CHEMISTRY

I M.Sc., CHEMISTRY

OUTCOME BASED EDUCATION CHOICE BASED CREDIT SYSTEM

SEMESTER - I

CORE COURSE - I

P23CHC101

ORGANIC REACTION MECHANISMS-I

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
Theory	6				5	25	75	100

Objectives of the course

- 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.

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.

UNIT-II: Aromatic and Aliphatic Electrophilic Substitution: Aromaticity: Aromaticity in 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.

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. S_N1 , ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.

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. Methods of determining the configuration. Prelog rules absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, 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, 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.

Recommended Text Books

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, 2ndedition, 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.
6. Sachin Kumar Ghosh Advanced General Organic Chemistry: A Modern approach: Volume I,II 3rd revised Edition

Website &E learning source

1. <https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic>
2. <https://www.organic-chemistry.org/>

Course Learning Outcomes: Students will be able

CO 1	To recall the basic principles of organic chemistry.
CO 2	To understand the formation and detection of reactive intermediates of organic reactions.
CO 3	To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.
CO 4	: To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds
CO 5	To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.

COURSE MAPPING CO-PSO

CO /PSO	PSO1	PSO2	PSO3	PSO4
CO1	4	4	4	4
CO2	4	4	4	4
CO3	4	4	2	3
CO4	4	4	3	2
CO5	4	4	3	3

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PCHC102

STRUCTURE AND BONDING IN INORGANIC COMPOUNDS

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
Theory	6				5	25	75	100

Objectives of the course

- 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.

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, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster; main group clusters – zintl ions and mno rule.

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 Bravais lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics:

Lattice energy – Born-Landé equation - Kapustinski equation, Madelung constant.

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.

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.

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.

Recommended Text

1. A R West, Solid state Chemistry and its applications, 2nd Edition (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: New York, 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: Students will be able		Level
CO 1	Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.	K2
CO 2	Understand the various types of ionic crystal systems and analyze their structural features.	K2
CO 3	Explain the crystal growth methods	K2
CO 4	To understand the principles of diffraction techniques and microscopic techniques.	K2
CO 5	Predict the geometry of main group compounds and clusters.	K6

CO-PSO Mapping

CO /PO	PSO1	PSO2	PSO3	PSO4
CO1	4	4	4	4
CO2	4	4	4	3
CO3	4	4	2	4
CO4	4	4	4	2
CO5	4	4	4	4

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SEMESTER – I

CORE COURSE – III

P23CHC103P

ORGANIC CHEMISTRY- PRACTICAL

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
Practical	5				5	25	75	100

Objectives of the course

- To understand the concept of separation, qualitative analysis and preparation of organic compounds.
- To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
- To analyze the separated organic components systematically and derivatize them suitably.
- To construct suitable experimental setup for the organic preparations involving two stages.
- To experiment different purification and drying techniques for the compound processing.

UNIT-I: Separation and analysis:

- A. Two component mixtures
- B. Three component mixtures.

UNIT-II: Single & Double stage preparations:

- a) *p*-Bromoacetanilide from aniline
- b) *p*-Nitroaniline from acetanilide
- c) 1,3,5-Tribromobenzene from aniline
- d) Acetyl salicylic acid from methyl salicylate
- e) Benzilic acid from benzoin
- f) *m*-Nitroaniline from nitrobenzene

g) *m*-Nitrobenzoic acid from methyl benzoate

Recommended Text

1. A R West, Solid state Chemistry and its applications, 2nd Edition (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.

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.

Website and e-learning source

https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

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Course Learning Outcomes: Students will be able		Level
CO 1	To recall the basic principles of organic separation, qualitative analysis and preparation	K1
CO 2	To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.	K2
CO 3	To determine the characteristics of separation of organic compounds by various chemical reactions	K5
CO 4	To develop strategies to separate, analyze and prepare organic compounds.	K6
CO 5	To formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations.	K6

COURSE MAPPING CO -PSO

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	4	S	4	3
CO2	4	4	S	3	2
CO3	4	4	M	4	4
CO4	4	4	S	3	4
CO5	4	4	S	4	4

SEMESTER – I

ELECTIVE COURSE-II

PcHE 1:2

P23CHDE3		ELECTROCHEMISTRY						
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				4	25	75	100

Objectives of the course

- To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
- To familiarize the structure of the electrical double layer of different models.
- To compare electrodes between current density and over potential.
- To discuss the mechanism of electrochemical reactions.
- To highlight the different types of over voltages and its applications in electroanalytical techniques.

UNIT-I: Ionics: Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.

UNIT-II: Electrode-electrolyte interface: Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces,

Electrocapillary phenomena - Lippmann equation. Electro-kinetic phenomena electro-osmosis, electrophoresis, Colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.

UNIT-III: Electrode of Elementary Electrode Reactions: Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents. Nernst equation. Model of three electrode system, over potential. Rate of electro chemical reactions: Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor.

UNIT-IV: Electrode of Multistep Multi Electron System: Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Reduction of I^3 , Fe^{2+} , and dissolution of Fe to Fe^{2+} . Overvoltage and over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.

UNIT-V: Concentration Polarization, Batteries and Fuel cells: Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Polarography-principle and applications. Cyclic voltammetry-anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems:

	Fuel	Cells:
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classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

Recommended Text

1. D. R. Crow, Principles and applications of electrochemistry, 4th edition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.

3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai, 2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.

Reference Books

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Website and e-learning source

1. <https://www.pdfdrive.com/modern-electrochemistry-e34333229>.

Course Learning Outcomes: Students will be able		Level
CO 1	To study different thermodynamic mechanism of corrosion,	K1
CO 2	To understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.	K2
CO 3	To have knowledge on storage devices and electrochemical reaction mechanism.	K2
CO 4	To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations	K4
CO 5	To discuss the theories of electrolytes, electrical double layer, electrodis and activity coefficient of electrolytes	K6

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4
CO1	4	4	4	4
CO2	4	4	4	4
CO3	4	2	2	3
CO4	4	4	4	4
CO5	4	4	4	4

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CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				4	40	60	100

OBJECTIVES

- ❖ To learn the basic principle of volumetric and gravimetric analysis

1. TITRIMETRY AND GRAVIMETRY

A mixture of solution(s) should be given for estimation

Cu (V) and Ni (G)

Cu (V) and Zn (G)

Fe (V) and Zn (G)

Fe (V) and Ni (G)

2. Tetramminecopper (II) sulphate

3. Potassium trioxalatoferrate

REFERENCE

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

C. 

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

OBJECTIVES

- ❖ To know the elementary ideas about textile chemistry.
 - I. Pre-treatment and dyeing, desizing, Scouring, Bleaching, Dyeing.
 - II. Combination on percentage of shade
 - 0.5% shade, 1% shade, 2% shade, 2% Combination shade
 - III. Fiber - Identification test
 - For cotton, Wool, Jute, Viscose, Silk, Polyester
 - IV. Preparation of Dye
 - Methyl orange and Phenol red

References

1. Chemistry of Dyes and Principles of dyeing by Dr.V.A.Shenai
2. Technology of textile fibre Dr.V.A.Shenai

COURSE OUTCOMES:

Course Learning Outcomes: Students will be able		Level
CO 1	Students will acquire knowledge about dying process	K1

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P23CHISE1		COSMETIC CHEMISTRY						
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				3	25	75	100

Objectives of the course

- To learn the chemistry involved in cosmetics, water purification and food.
- To prepare cosmetics, analyze water samples and identify the adulterants in food samples.

UNIT-I History of cosmetics, classification of cosmetics, professional image of self grooming, beauty and wellness.

UNIT-II Cosmetics emulsions: cream, cleansers, powders, moisturisers, sun screen, acne and anti aging creams. Chemical peels and peeling agents, lasers and light devices, bath salts, gels, soaps, bubble baths and scrubs

UNIT-III Skin Care General Anatomy and Physiology of skin, Structure of skin, Growth and nutrition, dermal fillers Hair Care Structure of hair, growth of hair, Cosmetics used for hair – Shampoos, conditioners, Bleaches, hair dyes, hair gels, hair perms and hair relaxers/straighteners.

UNIT-IV Nail Care Structure of nail, cosmetics used for nail – Nail lacquer, nail polish remover, Manicure and Pedicure, nail care techniques.

UNIT-V Eye Care Cosmetics used for eye – eye brow pencil, eye liner, eye shadows, mascaras. Eye concealer and eye creams.

Reference Books:- • Perry Romanowski, Beginning Cosmetic Chemistry, Allured Pub Corp.2009. • Dr. Ramesh Kumari, Chemistry of Cosmetics, Prestige Publishers.

Course Learning Outcomes: Students will be able		Level
CO 1	Understand water purification process, food sources and analyze adulterants food	K2
CO 2	Identify the types of cosmetics and learn about their chemistry	K3
CO 3	Articulate the ingredients present in personal care products and apply it in their preparation.	K4

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	4	4	4	4
CO2	4	2	3	3	3
CO3	4	3	3	2	3

C. J. Ami

PCHC204

P23CHC204 ORGANIC REACTION MECHANISM-II								
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

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.

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- dicyclohexyl carbodiimide (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, Prins reaction. 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 of esters.

UNIT-V: Reagents and Modern Synthetic Reactions: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride (NaBH₃CN), *meta*-Chloroperbenzoic acid (m-CPBA),

Dimethyl aminopyridine (DMAP), $n\text{-Bu}_3\text{SnD}$, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperidin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB), Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($\text{Cu}(\text{acac})_2$), TiCl_3 , NaIO_4 , Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex, Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.

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*, 8thedn, New Age International Publishers, 2015.
4. P. Y. Bruice, *Organic Chemistry*, 7thedn., 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*, 5thedn, 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*, 4thed., John-Wiley, 2010.

Website and e-learning source

1. <https://sites.google.com/site/chemistryebookscollection02-chemistry/organic>

2. <https://www.organic-chemistry.org/>

Course Learning Outcomes (for Mapping with POs and PSOs)

Course Learning Outcomes: Students will be able

CO 1	To recall the basic principles of aromaticity of organic heterocyclic compounds.
CO 2	To understand the mechanism of various types of organic reactions.
CO 3	To correlate the principles of substitution, elimination addition reactions
CO 4	To predict the suitable reagents for the conversion of selective organic compounds.
CO 5	To design new routes to synthesis organic compounds

COURSE MAPPING CO -PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4
CO1	4	S	4	3
CO2	4	S	4	4
CO3	4	M	3	3
CO4	4	S	4	4
CO5	4	S	4	3

C. Jethim

PC11C205

P23CHC205		PHYSICAL CHEMISTRY-I						
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

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.

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, canonical particles. 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. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy. equilibrium constants and equipartition principle. Heat capacity of mono and di atomic gases-ortho and para hydrogen. 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.

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. Benjamin Publishers, 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. Mcquarrie 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. Ytsimiriski, "Kinetic Methods of Analysis", Pergamon 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:

Course Learning Outcomes: Students will be able		Level
CO 1	To explain the classical and statistical concepts of thermodynamics	K1
CO 2	To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.	K5
CO 3	To compare the theories of reactions rates and fast reactions.	K5
CO 4	To discuss the various thermodynamic and kinetic determination.	K6
CO 5	To evaluate the thermodynamic methods for real gases and mixtures.	K6

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	4	4	4	4
CO2	4	4	4	4	4
CO3	4		4	4	4
CO4	4	4	4	4	4
CO5	4	4	4	4	2

C. H. Ami

P23CHC206 INORGANIC CHEMISTRY PRACTICAL								
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				3	25	75	100

Objectives of the course

- To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
- To recall the principle and theory in preparing standard solutions.
- To train the students for improving their skill in estimating the amount of ion accurately present in the solution
- To estimate metal ions, present in the given solution accurately without using instruments.
- To determine the amount of ions, present in a binary mixture accurately.

UNIT-I: Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I : W, Tl and Pb.

Group-II : Se, Te, Mo, Cu, Bi and Cd.

Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.

Group-IV : Zn, Ni, Co and Mn.

Group-V : Ca, Ba and Sr.

Group-VI : Li and Mg.

UNIT-II: Preparation of metal complexes: Preparation of inorganic complexes:

1. Preparation of tris thioureacopper(I)sulphate
2. Preparation of potassium trioxalate chromate(III)
3. Preparation of tetramminecopper(II) sulphate
4. Preparation of hexathioureacopper(I) chloridedihydrate
5. Preparation of sodium trioxalato ferrate(III)
6. Preparation of hexathiourealead(II) nitrate

UNIT-III: Complexometric Titration:

1. Estimation of zinc,
2. Estimation of nickel,
3. Estimation of magnesium,
4. Estimation of calcium

Recommended Text

1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded., The National Publishing Company, Chennai, 1974.
3. *Vogel's Text book of Inorganic Qualitative Analysis*, 4thed., ELBS, London.

Reference Books

1. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965.
2. W. G. Palmer, *Experimental Inorganic Chemistry*; Cambridge University Press, 1954

C. J. Ami

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.	K2
CO 2	To identify the anions and cations present in a mixture of salts.	K3
CO 3	To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.	K3
CO 4	To choose the appropriate chemical reagents for the detection of anions and cations	K5
CO 5	To synthesize coordination compounds in good quality	K6

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COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	4	3
CO2	4	4	4	4	4
CO3	4	3	4	4	4
CO4	4	2	4	4	4
CO5	3	4	3	4	3

P23CHDE5 ESTIMATION OF ORGANIC COMPOUNDS -PRACTICAL

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				4	40	60	100

UNIT-I: Estimations:

- Estimation of Phenol (bromination)
- Estimation of Aniline (bromination)
- Estimation of Ethyl methyl ketone (iodimetry)
- Estimation of Glucose (redox)
- Estimation of Ascorbic acid (iodimetry)
- Estimation of Aromatic nitro groups (reduction)
- Estimation of Glycine (acidimetry)
- Estimation of Formalin (iodimetry)
- Estimation of Acetyl group in ester (alkalimetry)
- Estimation of Hydroxyl group (acetylation)
- Estimation of Amino group (acetylation)

Recommended Text

- A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
- A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
- L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.

Reference Books

- D, E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
- R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
- C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.

Website and e-learning source

https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

C. J. Phiri

P23CHDE5 QUALITATIVE & QUANTITATIVE ANALYSIS OF PHYTOCHEMICALS

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				4	40	60	100

UNIT-1 Introduction to phytochemistry, extraction, different types of Extraction methods, Solvent selection, qualitative and quantitative phytochemical analysis, Fractionation and purification, Identification and Characterisation of phytochemicals (TLC, HPLC, LC-MS, GC-MS, NMR etc..)

UNIT-2 Metabolic pathways in higher plants and their determination a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways-shikimic acid pathway, Acetate pathway b) Study of Utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-3 General introduction, composition, chemistry & chemistry classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: Alkaloids: Vinca, Rauwolfia, Belladonna, Opium, Phenylpropanoids and Flavonoids; Lignans, Tea, Ruta, Steroids, Cardiac glycosides & Triterpenoids and flavonoids, Dioscorea, Digitalis.

UNIT-4 VOLATILE OILS

Mentha, Clove, Cinnamon, Fennel, Coriander, Tannins: Catechu, Pterocarpus, Resins: Benoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony, Glycosides: Senna, Aloes, Bitter almond, Iridoids, other terpenoids & Naphthaquinones: Gentian, Artemisia, Txus, carotenoids.

UNIT-5

Isolation, Identification and analysis of Phytoconstituents; a) Terpenoids: Menthol, Citral, Artemisin, b) Glycosides: Glycyrrhetic acid & Rutin, c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine d) Resins: Podophyllotoxin, Curcumin.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	Estimate the organic compounds like phenol, aniline, ketone, glucose.	K2
CO 2	Able to determine saponification value of an oil and iodine value of an oil.	K4

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	4	3
CO2	4	4	4	4	4

P23CHDE5		MEDICINAL CHEMISTRY						
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				4	25	75	100

Objectives of the course

- 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.

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.

UNIT-II: Antibiotics: Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicillins and tetracyclins, clinical application of penicillins, cephalosporin. Current trends in antibiotic therapy.

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.

Same as 12th
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.

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.

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. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn.
4. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
5. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.

Reference Books

1. Foye's Principles 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. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn.
 4. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers.1995.
 5. S. Ramakrishnan, K. G. Prasannan and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 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:

Course Learning Outcomes: Students will be able		Level
CO 1	Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design.	K2
CO 2	Explain the relationship between drug's chemical structure and its therapeutic properties	K2
CO 3	To identify different targets for the development of new drugs for the treatment of infectious and GIT.	K3
CO 4	Designed to give the knowledge of different theories of drug actions at molecular level.	K6
CO 5	Predict a drugs properties based on its structure	K6

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	4	4	4	4
CO2	4	3	4	3	4
CO3	4	4	4	4	3
CO4	4	2	4	4	4
CO5	4	4	2	4	4

C. Hmi

PC HC 251

P23CHDE6

GREEN CHEMISTRY

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

Objectives of the course

- To discuss the principles of green chemistry.
- To propose green solutions for chemical energy storage and conversion.
Propose green solutions for industrial production of Petroleum and Petrochemicals.
- To Propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
To Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.

UNIT-I: Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, international green chemistry organizations and Twelve principles of Green Chemistry with examples.

UNIT-II: Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water, Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in scCO_2 . Green synthesis-adipic acid and catechol.

UNIT-III: Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.

UNIT-IV: Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.

UNIT-V: Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.

Recommended Text

1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.
2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill, New Delhi, 2005.
3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall, 1974.
4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001.
5. A. K. De, Environmental Chemistry, New Age Publications, 2017.

Reference book

1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001
3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000
4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.
5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books

and Allied (P) Ltd, 2019.

Website and e-learning source

1. <https://www.organic-chemistry.org/>
2. <https://www.studyorgo.com/summary.php>

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To recall the basic chemical techniques used in conventional industrial preparations and in green innovations	K1
CO 2	To understand the various techniques used in chemical industries and in laboratory.	K2
CO 3	To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.	K3
CO 4	To compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.	K5
CO 5	To design and synthesize new organic compounds by green methods.	K6

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	3	3	3	2
CO2	4	4	4	4	4
CO3	4	4	3	4	4
CO4	4	4	4	4	4
CO5	4	3	3	3	4

PCH2SE2

P23CH2SE2 BASIC CLINICAL CHEMISTRY								
CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	2				2	25	75	100

Objectives of the course

- After going through the course the student is expected to learn about
- The disinfectants and antiseptics.
- The important drugs and the mode of actions.
- Enzymes
- Body fluids

UNIT I CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS

Definition of health. Ryde of WHO. Sterilization of surgical instruments. Disinfectants, antiseptics, sanitation. Biochemical analysis of urine, serum and fecal matter. Treatment for specific poisons-acids, alkalis, arsenic and mercury compounds.

UNIT II - COMMON DRUGS

Manufacture of drugs –quinine, reserpine, atropine and d – tubocurarine from indian medicinal plants.

Narcotic analgesics (only morphine compds). Antipyretic analgesics (acetyl salicylic acid, p – amino – phenol derivatives).

Muscle relaxants. i. Acting at neuromuscular junction (d – tubocurarine chloride). ii. Acting at spinal cord alone (glyceryl guaiacolate, diazepam).

Antibiotics -pencillin, Cardiovascular drugs-nitrates, beta blockers (propranolol and atenolol) and calcium channel blockers.

UNIT III - ENZYMES

Classification, specificity. Coenzymes, Cofactor, ATP, Mechanism of enzyme action and Immobilisation of enzymes.

Specific action of enzymes, factors affecting enzyme activity

UNIT-IV BODY FLUID

Blood volume, blood groups, coagulation of blood. Plasma lipoproteins.

Blood pressure. Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anaemia. Blood transfusion. Blood sugar and diabetes.

Knowledge of measuring blood pressure, influence of blood pressure, blood sugar control levels and medicine used to control blood pressure and blood sugars

UNIT-V: BIOTECHNOLOGY

Heredity, recombinant DNA, Genetic engineering and its possible hazards.

Gene splicing, manufacture of interferon and human insulin (Humulin).

Drug manufacture based on fermentation (only antibiotics)

Recommended Text

Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S.Chand and Co. Ltd, 1999.

S.C. Rastogi, Biochemistry, Tata McGraw Hill Publishing Co., 1993 Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993.

Reference Books

1. O.Le Roy, Natural and synthetic organic medicinal compounds, Ealemi., 1976.

2. B.L. Oser, Hawk's physiological chemistry, 14th edition, Tata-McGraw - Hill Publishing Co.Ltd, 1965

3. O. Kleiner and J. Martin, Bio-Chemistry, Prentice-Hall of India(P) Ltd, New Delhi,

Course Outcomes

At the end of the course students will be able to

Course Learning Outcomes: Students will be able		Level
CO 1	Know the clinical hygiene and bio chemical analysis	K1
CO 2	Understand the chemistry of analgesics, Muscle relaxants, Antibiotics, enzymes and body fluids	K2
CO 3	know the Manufacture of drugs	K6

COURSE MAPPING CO-PSO

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	4	4	4	4	4
CO2	4	4	4	4	4
CO3	4	4	4	4	4

C. H. Hmi

Course Learning Outcomes: Students will be able		Level
CO 1	To understand the bonding in polymers.	K2
CO 2	To observe and record the processing of polymers.	K2 K3
CO 3	To scientifically plan and perform the various polymerization reactions.	K4, K6
CO 4	To calculate the molecular weight by physical and chemical methods.	K5
CO 5	To interpret the experimental data scientifically to improve the quality of synthetic polymers	K5

COURSE MAPPING CO-PSO

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
O1	4	4	4	4	4
O2	4	4	3	3	2
O3	4	4	4	4	4
O4	4	4	2	4	4
O5	4	4	4	4	2

C. J. Hani

*Checked
C. J. Hani*

**SEMESTER – I
P23CHDEI**

**ELECTIVE COURSE-I
POLYMER CHEMISTRY**

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				4	25	75	100

Objectives of the course

- 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.

UNIT-I: Characterization, Molecular weight and its Determination:

Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests, thermal methods, T_g , 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.

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.

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, photodegradation, Photo stabilizers, Solid and gas phase polymerization.

UNIT-IV: Industrial Polymers: Preparation of fibre forming elastomeric material. Thermoplastics: Polyethylene, Polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoroethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde resin, Epoxide resin. Elastomers: Natural rubber and synthetic rubber Buna-S and neoprene. Conducting Polymers: Elementary ideas of poly sulphur nitriles, poly phenylene, poly pyrrole and poly Polymethylmethacrylate, polyimides, polyamides, polyurethanes polyethylene and polypropylene glycols.

UNIT-V: Polymer Processing: Compounding: Polymer Additives: Plasticizers, antioxidants, thermal stabilizers, fire retardants and Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcement casting, Thermofoaming, Foaming. Catalysis and catalyst support, clay compounds, catalyst, auto-exhaust catalysis, vanadium, heterogeneous and active centres.

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
2. A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science Engineering*, Tata McGraw-Hill, 1978.

POST GRADUATE PROGRAMME OUTCOMES

PO 1: Disciplinary Knowledge: Ability to apply disciplinary knowledge and demonstrate comprehensive knowledge by understanding concepts and providing effective solutions.

PO 2: Communication Skills: Enable the students to understand and transfer knowledge both orally and in writing.

PO 3: Critical Thinking, Problem-solving & Analytical Reasoning: Capability to apply analytical skills to analyze and evaluate evidence/arguments, claims and beliefs based on empirical evidence; formulate coherent arguments; critically evaluate practices, policies and theories; to solve different kinds of non-familiar problems and to apply one's learning to real-life situations; draw valid conclusions and support them with evidence and examples by following systematic approach.

PO 4: Research-related skills : Ability to recognize & predict cause-and-effect relationships, formulate, test and establish hypotheses, analyse, interpret and draw conclusions from data; ability to plan, execute and report the results of an experiment or investigation.

PO 5: Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values, formulate a position/argument about an ethical issue from multiple perspectives, use ethical practices and avoid unethical behaviour. Ability to appreciate environmental and sustainability issues.

PO 6: Team Work & Leadership : Ability to emphasis on accomplishing tasks as a group, setting directions, building a team to achieve the vision and use management skills to guide people to the right destination, smoothly and efficiently.

PO 7: Self-directed & Lifelong learning & Digital literacy: Ability to acquire and enhance knowledge and skills using ICT through self-paced and self-directed Learning and Life-long learning.

PSO-PG

On the successful completion of M.Sc Chemistry program students will be able

PSO 1: To get in-depth knowledge on advanced concepts in Inorganic, Organic, Physical, Analytical, Biological, environmental and industrial applications of chemistry.

PSO 2: Ability to write clear, coherent and well-structured scientific reports, research papers and proposals that effectively communicate complex chemical concepts and findings.

PSO 3 : Assess the validity of experimental results from a study on reaction kinetics, identifying any potential sources of error and evaluating the robustness of the conclusions.

PSO 4 : Analyse and understand the cause and effect relationships in chemical processes and reactions and predict their outcomes based on theoretical principles and empirical evidences.

PSO 5 : Demonstrate a commitment to ethical practices in research, including honesty in data reporting, avoidance of plagiarism and respect for intellectual property.

PSO 6 : Demonstrate the ability to lead and coordinate a research team effectively, ensuring that each member contributes to the overall research goal

PSO 7: Demonstrate the ability to set personal learning objectives and pursue relevant ICT-based resources to achieve these goals.

SEMESTER – III
CORE COURSE-VII
ORGANIC SYNTHESIS AND PHOTOCHEMISTRY

PCHC307

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				6	25	75	100

Objectives of the course:

- 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.

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, alternate synthetic routes, key intermediates that would be formed, available starting materials and resulting yield of alternative methods. Linear Vs convergent synthesis. 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.

UNIT-II: Organic Synthetic Methodology:

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. 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.

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

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-II: Photochemistry of α, β -unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationary state; di- π -methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reactions.

Recommended Text

1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5th ed., 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.

- Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
- M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.

Reference Books

- Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974.
- J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004.
- W. Caruthers, Some Modern Methods of Organic Synthesis 4th edn, Cambridge University Press, Cambridge, 2007.
- H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972.
- Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.

Website and e-learning source :

<https://rushim.ru/books/praktikum/Monson.pdf>

Course Learning Outcomes (for Mapping with POs and PSOs)

Course Learning Outcomes: Students will be able		Level
CO 1	To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms	K1
CO 2	To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions	K2
CO 3	To implement the synthetic strategies in the preparation of various organic compounds	K3,K6
CO 4	: To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds.	K6
CO 5	To design and synthesize novel organic compounds with the methodologies learnt during the course.	K6

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	4	4	4	4
CO 3	2	4	4	4	4
CO 4	4	4	4	4	4
CO 5	4	4	2	4	4

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CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

Objectives of the course

- 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 poly electronic systems.
- To familiarize the symmetry in molecules and predict the point groups.
- To predict the vibrational modes, hybridization using the concepts of group theory.

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.

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.

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.

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} , T_d and O_h . 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.

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.

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.

- Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition.
- T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition.
- G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001.
- D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.

Reference Books

- N. Levine, Quantum Chemistry, Allyn & Bacon Inc, 1983, 4th edition.
- D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012.
- 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
- J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint.

Website and e-learning source :

- <https://nptel.ac.in/courses/104101124>
- <https://ipc.iisc.ac.in/~kls/teaching.html>

Course Learning Outcomes: Students will be able		Level
CO 1	To apply the concept of quantum mechanics and group theory to predict the electronic structure.	K3
CO 2	To classify the symmetry operation and wave equations.	K4
CO 3	To specify the appropriate irreducible representations for theoretical applications.	K4
CO 4	To discuss the characteristics of wave functions and symmetry functions	K6
CO 5	To develop skills in evaluating the energies of molecular spectra.	K6

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	3	3	2
CO 2	4	4	2	3	3
CO 3	4	4	4	4	4
CO 4	4	4	4	4	4
CO 5	4	4	4	4	4

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**SEMESTER – III
CORE COURSE-IX
INDUSTRIAL CHEMISTRY** PCHC309

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				5	25	75	100

COURSE OBJECTIVES

- On successful completion of this course, students will be able to
- Identify the types and composition of glasses, paints and cements.
 - Compare the different methods of polymerisation.
 - Utilize the manufacturing methods of cement, glass and paint.
 - Apply the knowledge of drugs in treating diseases.
 - Analyze the industrial applications of paint, glass and cement.

Unit-I Glass

Glasses – composition of glass – types of glasses – manufacturing methods – formation processes – melting, blowing, pressing, annealing and finishing – industrial applications of glasses .

Unit –II Cement

Cement – composition of cement – raw materials – cement factories in india– types of cement – portland cement – composition, types – manufacturing methods– dry and wet processes –setting of cement–applications.

Unit–III Paints and Pigments

Paints – composition of paint – types of paints, manufacturing methods– applications – pigments – classification of pigments and dyes – examples – industrial applications.

Unit –IV Drugs

Drugs – classification of drugs – definition and examples of antipyretics, antibiotics, antiseptics, analgesics, anti-convulsant agents, anaesthetics and cardiovascular drugs.

Unit- V Polymers

Monomers and polymers – definition of polymerisation– types– addition polymerisation and condensation polymerization– examples – uses – moulding types– injection and blow moulding – industrially important polymers.

Reference Books

1. Sharma B K, *Industrial Chemistry*, 15th Edition, Goel publishing house, Meerut, 2006.
2. Jayashree Ghosh, *Fundamental Concepts of Applied Chemistry*, S.Chand and Co. Ltd, 2006. (6 Hours)
3. Charkarabathy B N, *Industrial Chemistry*, Oxford and IBH Prb. Co., New Delhi, 1981.
4. Ashutosh Kar, *Medicinal Chemistry*, Wiley Eastern limited, New Delhi, 1993. (6 Hours)
5. Gowariker V R, Viswanathan N V and Sreedhar J, *Polymer Science*, New Age International, New Delhi, 2011.

Course Learning Outcomes: Students will be able		Level
CO 1	Apply the knowledge of drugs in treating diseases.	K3
CO 2	Analyze the industrial applications of paint, glass and cement.	K4
CO 3	Compare the different methods of polymerisation.	K4
CO 4	Identify the types and composition of glasses, paints and cements.	K5
CO 5	Utilize the manufacturing methods of cement, glass and paint.	K6

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	4	4	4	3
CO 2	2	4	4	4	3
CO 3	4	4	4	2	3
CO 4	4	4	4	4	3
CO 5	4	4	4	4	3

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SEMESTER – III
CORE COURSE-X
PHYSICAL CHEMISTRY PRACTICAL

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				3	25	75	100

COURSE OBJECTIVES

- To understand the principle of conductivity experiments through conductometric titrations.
- To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
- To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
- To determine the kinetics of adsorption of oxalic acid on charcoal.
- To develop the potential energy diagram of hydrogen ion, charge density distribution and Maxwell's speed distribution by computational calculation.

UNIT-I: Conductivity Experiments

1. 1.Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.

2. Verification of Ostwald's Dilution Law & Determination of pKa of a weak acid.
3. Verification of Kohlrausch's Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vs NaOH).
6. Precipitation titrations (mixture of halides only).

UNIT-II: Kinetics

1. 1.Study the kinetics of acid hydrolysis of an ester, determine the temperature coefficient and also the activation energy of the reaction.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.

UNIT-III: Phase diagram

Construction of phase diagram for a simple binary system

1. Naphthalene-phenanthrene
2. Benzophenone- diphenyl amine

Adsorption

Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).

Recommended Text

1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
3. V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008.
4. E.G. Lewers, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Ed., Springer, New York, 2011.

Reference Books

1. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
3. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014.
5. F. Jensen, Introduction to Computational Chemistry, 3rd Ed., Wiley-Blackwell.

Website and e-learning source https://web.iitd.ac.in/~nukurur/2015-16/lsem/cmp511/lab_handout_new.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To recall the principles associated with various physical chemistry experiments	K1
CO 2	To scientifically plan and perform all the experiments.	K3
CO 3	To observe and record systematically the readings in all the experiments.	K4
CO 4	To calculate and process the experimentally measured values and compare with graphical data	K5
CO 5	To interpret the experimental data scientifically to improve students' efficiency for societal developments	K5

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	2	4	2	4
CO 3	4	4	4	4	4
CO 4	4	4	4	4	4
CO 5	4	4	4	4	4

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SEMESTER – III PCH E3:1
ELECTIVE COURSE-V
BIOMOLECULES AND HETEROCYCLIC COMPOUNDS

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	4				3	25	75	100

COURSE OBJECTIVES

- To learn the basic concepts and biological importance of biomolecules and natural products.
- To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
- To understand the functions of alkaloids and terpenoids.
- To elucidate the structure determination of biomolecules and natural products.
- To extract and construct the structure of new alkaloids and terpenoids from different methods.

UNIT-I: Chemistry and metabolism of carbohydrates:

Definition, classification and biological role of carbohydrates. Monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides: Starch, Cellulose structure and properties

UNIT-II: Amino acids:

Amino acids structure, Classification, physical and chemical properties. Peptides-peptide bond, peptide synthesis, biologically important peptides. Proteins: classification, physical and chemical properties, Biological importance, Primary, Structure, secondary, Tertiary and quaternary structure-forces stabilising the structure of proteins.

UNIT-III: Lipids:

Lipids classification and biological importance. Simple lipids: types of fatty acids, triglycerides, waxes. Compound lipids-structure and functions-phospholipids, sphingolipids and glycolipids. Lipoproteins –classification and composition, Steroids and prostaglandins-structure and functions. Characterization of oils: Reichert-Meisel value, Iodine number, saponification value, acid number and determination of acetyl value.

UNIT-IV: Vitamins

Vitamins- Definition and classification, source, Structure and Biological role, daily requirement and deficiency manifestation of the fat soluble vitamins, A, D, E & K. Water soluble vitamins-Ascorbic acid, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, lipoic acid, biotin, folic acid and vitamin B12

UNIT-V: Fused Ring Heterocyclic Compounds:

Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.

Recommended Text

1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007.

2. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975.
3. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000.
4. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.
5. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009.

References Book

1. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia, 2004.
2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000.
3. Shoppe, Chemistry of the steroids, Butterworthes, 1994.
4. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad, 2004.
5. M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi, 2005.

Website and e-learning source

<https://www.organic-chemistry.org/>
<https://www.studyorgo.com/summary.php>
<https://www.clutchprep.com/organic-chemistry>

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To understand the basic concepts of biomolecules and natural products	K1
CO 2	To illustrate the applications of biomolecules and their functions in the metabolism of living organisms	K2
CO 3	To integrate and assess the different methods of preparation of structurally different biomolecules and natural products.	K4

CO 4	To analyse and rationalise the structure and synthesis of heterocyclic compounds.	K4
CO 5	To develop the structure of biologically important heterocyclic compounds by different methods.	K6

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	4	4	4	4
CO 3	2	4	4	4	4
CO 4	4	4	2	4	4
CO 5	4	4	4	4	4


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SEMESTER – III
ELECTIVE COURSE-V
PHARMOCOGNOSY AND PHYTO CHEMISTRY

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	4				3	25	75	100

COURSE OBJECTIVES

- To develop the knowledge of natural products, biological functions and pharmacological uses.
- To develop knowledge on primary and secondary metabolites and their sources.
- To understand the concepts of isolation methods and separation of bioactive compounds.
- To provide the knowledge on selected glycosides and marine drugs.
- To familiarize the guidelines of WHO and different sampling techniques.

UNIT-I: Pharmacognosy and Standardization of Herbal drugs:

Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine, and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.

UNIT-II: Extraction Techniques:

General methods of extraction, types – maceration, Decoction, percolation, Immersion and Soxhlet extraction. Advanced techniques-counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.

UNIT-III: Drugs containing Terpenoids and volatile oils:

Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrins; taraxasterol: Structure and pharmacological applications.

UNIT-IV: Drugs containing alkaloids:

Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.

UNIT-V: Plant Glycosides and Marine drugs: Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides- Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.

Recommended Text

1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House.

2. S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.

References Book

1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer.
2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2 nd edition, New age international (P) limited, New Delhi.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To recall the sources of natural medicines and analysis of crude drugs.	K1
CO 2	To understand the methods of evaluation based on various parameters	K2
CO 3	To apply various techniques to discover new alternative medicines.	K3
CO 4	To analyze the isolated drugs	K4
CO 5	To evaluate the isolated drugs for various pharmacological activities	K5

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	3	4	4
CO 2	4	4	3	4	4
CO 3	4	4	2	4	4

CO 4	4	4	4	4	4
CO 5	4	4	4	4	4

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**SEMESTER – III
INTER DISCIPLINARY COURSE
FOOD & NUTRITION**

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	2				2	25	75	100

Course objectives:

This course aims at enabling the students to realize the scope of food processing industry in India. It deals with various food additives, flavours, food colours and role of enzymes in food industry. This course includes the various food processing, preservation techniques and canning of fruits and vegetables.

Course Outcome:

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

- Explain the scope of fruit and vegetables preservation and properties of enzymes
- Classify food additives and predict the components of flavour
- Illustrate the natural colouring matters give examples for food spoilage and predict the characteristics and storage conditions of food
- Explain the principles and methods of preservation and the process of canning
- Apply the drying techniques and quality control in food processing

Unit-1

Introduction – history of preservation and canning industry- scope of fruit and vegetable preservation in India - product mix-availability - manpower-capital- lack of awareness- marketing facilities – transport facilities-availability of containers – publicity -role of Government.

Enzymes in the food industry- important properties of enzymes in fruit and vegetable technology – enzymes used in the food industry-immobilized enzymes

Unit-II

Food additives - functions and uses of food additives -classification of food additives - B.V.O - substances prohibited in foods-additives to be used with caution

Flavours - flavour compounds – flavonoids – terpenoids - sulfur compounds - other volatile components - types of flavor - developed flavor - processed flavor - added flavour- Texturing agents – gelatin-Sweeteners- artificial sweeteners

Unit-III

Food colors, Natural coloring matters – chlorophylls – carotenoids – anthocyanins – flavonoids –anthocyanins – tannins - quinines and xanthon- betalains

Synthetic colors - banned colors

Spoilage - Microbial spoilage - bacteria, yeast, moulds-enzymatic spoilage - spoilage by insects,parasites and rodents - characteristics and storage conditions of food.

Unit-IV

Principles and methods of preservation – Asepsis - preservation by high temperature – pasteurization – sterilization - Aseptic canning – preservation by low temperature - chemicals, sulphur dioxide, benzoic acid – drying – filtration – carbonation – sugar –fermentation – salt – acids - oils and spices – antibiotics - irradiation.

Canning and bottling of fruits and vegetables - principles and process of canning - different methods - canning of fruits - canning and bottling of vegetables - canning of curried vegetables - specific requirements for canning of fruits and tomatoes.

Unit-V

Fruits and vegetables drying/dehydration-techniques- advantages of dehydration over sundrying

Freezing of fruits and vegetables - methods of freezing - sharp freezing - quick freezing -cryogenic freezing - dehydro-freeze drying

References

1. M.Swaminathan, Food and nutrition.
2. Sri lakshmi, Food and nutrition.

Course Learning Outcomes: Students will be able		Level
CO 1	Explain the scope of fruit and vegetables preservation and properties of enzymes	K2
CO 2	Illustrate the natural colouring matters give examples for food spoilage and predict the characteristics and storage conditions of food	K2
CO 3	Explain the principles and methods of preservation and the process of canning	K2
CO 4	Apply the drying techniques and quality control in food processing	K3
CO5	Classify food additives and predict the components of flavour	K4

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	2	4	4	4
CO 3	4	3	4	2	3
CO 4	4	4	3	4	4
CO 5	4	4	3	4	4


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**SEMESTER – III
ECC- III
GENERAL STUDIES FOR RESEARCH FELLOWSHIP AND
LECTURERSHIP**

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY					2			100

UNIT-1

TEACHING APTITUDE

Teaching-Nature ,Objectives, Characteristics and Basic requirements,Learners characteristics, Factors affecting teaching,Methods of teaching, Teaching aids, Evaluation systems.

UNIT-2

RESEARCH APTITUDE

Research-Meaning, Characteristics and types,Steps of research, Methods of research, Research ethics,Paper,Article,workshop,Seminar,Conference and symposium. Thesis writing-Its characteristics and format.

UNIT-3

MATHEMATICAL REASONING

Series-Completion and its types, Classification-Verbal,letter,Number,coding and decoding

UNIT-4

LOGIC METHODOLOGY AND DATA ANALYSIS

Statement ;premises;Term-Types of Syllogism,Prepositions,Logical inferences; Fallacies or possible errors in logical conclusions-types of tables and graphs

,Intrepretation of data- sources,acquisition and interpretation,qualitative and quantitative data,Graphical representation and mapping of data.

UNIT-5

INFORMATION AND COMMUNICATION TECHNOLOGY

Overview of computer-Hardware ,Sofdtware, Internet and e-mailing.
EDUSAT-Space science and communication-Milestones,SPACE
TRANSPORTATION-Earth Observations.

References Book

1.UGC-NET/JRF/SET Teaching &Research Aptitude by Dr.M.S.Ansari &RPH
EDITORIAL Board 2014.Ramsh publishing House,New delhi.

Course Learning Outcomes: Students will be able		Level
CO 1	Understand the basics of Teaching and research aptitude	K2
CO 2	. Understand the methods of solving aptitude questions.	K2

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	3	4	4	3


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SEMESTER – IV
CORE COURSE-XI
COORDINATION CHEMISTRY *PCHC411*

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				6	25	75	100

COURSE OBJECTIVES

- 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.

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 antispinel 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.

UNIT-II: Spectral characteristics of complexes:

Term 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 Racah parameter and calculation of inter-electronic repulsion parameter.

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, Polarographic 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.

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 Energy; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakov test.

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.

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, 6th ed.; Wiley Inter-science: New York, 1988.

Reference Book

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:

Course Learning Outcomes: Students will be able		Level
CO 1	Understand and comprehend various theories of coordination compounds.	K2
CO 2	Understand the spectroscopic and magnetic properties of coordination complexes	K2
CO 3	Explain the stability of complexes and various experimental methods to determine the stability of complexes.	K2
CO 4	Predict the electronic transitions in a complex based on correlation diagrams and UV-visible spectral details.	K6
CO 5	Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes	K6

PSO1	PSO2	PSO3	PSO4	PSO5	PSO1
CO 1	4	4	4	4	4
CO 2	4	2	4	4	4
CO 3	4	3	2	4	4
CO 4	4	3	3	4	4
CO 5	4	3	3	4	4

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23/12/25

**SEMESTER – IV
CORE COURSE-XII
ANALYTICAL INSTRUMENTATION TECHNIQUES-PRACTICAL**

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	6				3	25	75	100

COURSE OBJECTIVES

- To design chromatographic methods for identification of species.
- To analyze different constituents through instrumental methods of analysis.
- To evaluate different contaminants in materials using turbidimetry and conductivity measurements.
- To design experiments for analysis of inorganic and organic materials.
- To analyze constituents in materials using emission and absorption techniques.

UNIT-I:

1. Determination of the equivalent conductance of a weak acid at different concentrations and verifying Ostwald dilution law. Calculation of the dissociation constant of the acid.
2. Determination of the equivalent conductance of a strong electrolyte at different concentrations and examining the validity of the Onsager's theory as limiting law at high dilutions.
3. Conductometric titration of a mixture of HCl and CH₃COOH Vs NaOH.
4. Conductometric titration of NH₄Cl Vs NaOH.
5. Conductometric titration of CH₃COONa Vs HCl.

6. Potentiometric titration of a mixture of HCl and CH₃COOH Vs NaOH
7. Determination of pK_a of weak acid by EMF method.
8. Potentiometric titration of FAS Vs K₂Cr₂O₇
9. Potentiometric titration of KI Vs KMnO₄.
10. Potentiometric titration of a mixture of Chloride and Iodide Vs AgNO₃.
11. Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode.
12. Study of the inversion of cane sugar in the presence of acid by Polarimetric method.

UNIT-II:

1. Estimation of Fe, Cu and Ni by colorimetric method.
2. Estimation of Na and K by flame photometric method.
3. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation.
4. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry.
5. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry.
6. Determination of the standard redox potential of ferri-ferrocyanide redox couple using cyclic voltammetry.
7. Estimation of the amount of sulphate present in the given solution using Nephelometric turbidimeter.
8. Estimation of the amount of nitrate present in the given solution using spectrophotometric method.
9. Heavy metal analysis in textiles and textile dyes by AAS
10. Determination of caffeine in soft drinks by HPLC
11. Analysis of water quality through COD, DO, BOD measurements.
12. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry
13. Estimation of chromium in steel sample by spectrophotometry
14. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry

15. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and comparing with specifications
16. Separation of (a) mixture of Azo dyes by TLC (b) mixture of metal ions by Paper chromatography
17. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry.
18. Estimation of Fe(II) by 1,10 phenanthroline using spectrophotometry

UNIT-III:

Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments

- 1.UV-Visible 2.IR 3.Raman 4.NMR 5.ESR 6.Mass etc.,

Recommended Text

1. Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003.
2. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, *Vogel's Textbook of Quantitative Chemical Analysis*; 6th ed., ELBS, 1989.
4. J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim, 1995.
5. Viswanathan and P.S.Raghavan, *Practical Physical Chemistry*, Viva Books, New Delhi, 2009.
6. Sundaram, Krishnan, Raghavan, *Practical Chemistry (Part II)*, S. Viswanathan Co. Pvt., 1996.

Reference Book

1. N. S. Gnanapragasam and G. Ramamurthy, *Organic Chemistry – Labmanual*, S. Viswanathan Co. Pvt. Ltd, 2009.
2. J. N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry*, S. Chand and Co., 2011.
3. J. B. Yadav, *Advanced Practical Physical Chemistry*, Goel Publishing House, 2001.
4. G.W. Garland, J.W. Nibler, D.P. Shoemaker, *Experiments in Physical Chemistry*, 8th edition, McGraw Hill, 2009.

5. J. N. Gurthu and R. Kapoor, *Advanced Experimental Chemistry*, S. Chand and Co., 1987.

Website and e-learning source

1. <https://bit.ly/3QESF7t>

2. <https://bit.ly/3QANOn>

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able						Level
CO 1	To recall the principles associated with various inorganic organic and physical chemistry experiments					K1
CO 2	To scientifically plan and perform all the experiments					K2
CO 3	To observe and record systematically the readings in all the experiments					K2
CO 4	To calculate and process the experimentally measured values and compare with graphical data.					K6
CO 5	To interpret the experimental data scientifically to improve students efficiency for societal developments					K6
CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	4	3	4	4	3	
CO 2	4	2	4	4	2	
CO 3	4	4	4	4	4	
CO 4	4	3	3	2	4	
CO 5	4	3	4	3	4	

SEMESTER – IV
ELECTIVE COURSE- VI
Industry / Entrepreneurship - practical
SOIL ANALYSIS PRACTICAL

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				4	25	75	100

OBJECTIVES

Apply the knowledge for usage of soil in agricultural field

Topic

1. Collection of Soil samples (Field work)
2. Determination of pH
3. Determination of Electrical Conductivity(EC)
4. Determination of Organic carbon
5. Determination of Calcium carbonate (free lime)
6. Determination of N,P,K availability in soil

References

1.Lambe, T.W. and Whitman, R.V. (1969), Soil Mechanics', John Wiley and Sons, Inc., New York.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To understand physical and chemical properties of soil	K1
CO 2	Apply the knowledge for usage in real life	K6

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	3	4	4	3


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SEMESTER – IV
ELECTIVE COURSE- VI
Industry / Entrepreneurship - practical

WATER ANALYSIS PRACTICAL

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				4	25	75	100

OBJECTIVES

Apply the knowledge for usage of soil in WATER MANEGEMENT field

1. Collection of water samples (Field work)
2. Determination of total hardness of water
3. Determination of alkalinity of water
4. Determination of pH of water
5. Determination of conductivity of water
6. Determination of TDS in water

References

1.Bartram J, Ballance R, eds (1996) *Water quality monitoring: A practical guide to the design and implementation of freshwater quality studies and monitoring programmes*. Published by E & FN Spon, London, on behalf of the United Nations Educational, Scientific and Cultural Organization, the World Health Organization and the United Nations Environment Programme (<https://apps.who.int/iris/handle/10665/41851>).

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

Course Learning Outcomes: Students will be able		Level
CO 1	To understand physical and chemical properties of water	K1
CO 2	Apply the knowledge for usage in real life	K6

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	3	4	4	3

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SEMESTER - IV
AEC-II
CHEMISTRY FOR **EXAM ASPIRANTS**

CATEGORY	HOURS				CREDITS	MARKS		
	L	T	P	O		CIA	INTERNAL	TOTAL
THEORY	5				2	25	75	100

Unit .1. Periodic properties

Variation of atomic volume, atomic and ionic radii, ionisation potential, electron affinity and electronegativity along periods and groups – Factors affecting periodic properties **VSEPR Theory:** Shapes of simple inorganic molecules (BeCl_2 , BF_3 , SiCl_4 , PCl_5 , SF_6 , IF_7 , H_2O , NH_3 , XeF_6) containing lone pair and bond pairs of electrons- Lewis structures.

Unit .2. Industrial Chemistry

Fuel gases-water gas, Producer gas, LPG gas, Gobar gas and Natural gas. Fertilizers – NPK and Mixed fertilizers, micro nutrients and their role in plant life and biofertilizers, Soap and Detergents and elementary idea about preparation and manufacture. Cleaning action of soap and detergents.petrochemicals,Polymer, Rubber.

Unit .3. Nuclear chemistry:

Introduction – composition of nucleus and nuclear forces-Elementary particles.

Nuclear stability –n/p ratio, mass defect, binding energy, packing fraction and magic numbers, shell and liquid drop models. Isotopes – detection and separation. Isobars, Isotones and Isomers.

Unit .4. Organic reactions

Aldol, Perkin, Knoevenagel and Benzoin condensation, Claisen, Reformatsky, Wittig and Cannizzaro reactions. Pinacol - pinacolone rearrangement. BeckmanBenzidine, Hoffmann, Curtius, Benzilic Acid, Cope and Oxycope rearrangement and fries rearrangement (Mechanisms not necessary)

Unit . 5. Analytical chemistry

Laboratory hygiene and safety. Storage and handling of corrosive chemicals, simple first aid procedure for accidents. Separation and purification techniques. Solvent extraction, Soxhlet extraction. Chromatography; Paper chromatography-principles, medium, solvents used,mechanism, factors influencing R_f valuesData values, Analytical instruments.

REFERNCES

1. A. R. West, Basic solid state chemistry, John Wiley, (1991).
2. S. Glasstone, Source Book on Atomic Energy, Van Nostrand Co., (1969).

3. G. Frielander, J. W. Kennedy and J. M. Miller, Nuclear and Radiochemistry, John
4. Hari Jeevan Arnikaar , Essentials of nuclear chemistry, New Age International (P) Ltd., (2005).
5. Hari Jeevan Arnikaar, Nuclear Chemistry Through Problems, New Age International (P).
6. G. T. Seaborg, Transuranium elements, Dowden Hitchinson and Ross, (1978).
7. Nishit Mathur, Nanochemistry, RBSA publishers (2010).
8. Patric Salomon, A hand book on Nano Chemistry, Dominant publishers and distributors (2008).
9. G. B. Sergeev, Nanochemistry, Elsevier Science and Technology (2007).
10. U. Saityanarayana, Essentials of Biochemistry, Books and Allied (P) Ltd.,

Course Learning Outcomes: Students will be able		Level
CO 1	Understand the laboratory hygiene and safety	K2
CO 2	Understand industrial applications of chemistry	K2

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	4	4	4	4	4
CO 2	4	3	4	4	3

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