ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU
(AFFILIATED TO UNIVERSITY OF MYSORE & REACCREDITED BY NAAC WITH B^{++} GRADE)

PROGRAMME: M.Sc., in CHEMISTRY

CBCS with Learning Outcome Based Curriculum
Academic years: 2020-22

{Approved in the Academic Council Meeting held on 12.01.2021}

{The Academic Year of 2020-21 was commenced on 24.01.2021 due to first wave of Covid-19 Pandemic}

The following modifications are incorporated in the revised syllabus from the Academic Year 2020-21

Sl.No	Semester	Existing paper replaced	New Paper	Credits	Justification	Percentage of Changes
1.	**First**	-	Good Laboratory Practices (largely Practical based) SC- **Ability Enhancement**	**2**	To gain the skill of handling, the glass wares and instruments. Also to apply the analytical methods and techniques in laboratories.	100%
2.		-	Green Chemistry SC-**Soft Skill**	**2**	To promote uptake of green chemistry amongst the chemical and chemical-using industries requires the exemplification of green chemistry in education and training and inspire the next generation of scientists.	100%
3.	**Second**	-	Chemistry of food and beverages SC- **Interdisciplinary**	**2**	To study the nature of foods, causes of deterioration and principles of food processing. It also creates an awareness of how to maintain the freshness of food while preparing, packaging and preserving the food products.	100%
4.		-	Water remediation and conservation SC- **Open Elective**	**2**	To familiarize with the importance of water conservation, water demand management and the impact of industrial and human contribution towards water pollution.	100%
5.		-	Bio fertilizers (Practical based course) **Certificate Course** SC- **Certificate Course**	**2**	To create awareness that, bio fertilizers are capable of providing an economically liable level for achieving the ultimate goal of enhanced productivity. The crop microbial soil ecosystem can, therefore, be energized in sustainable agriculture.	100%
6.	**Third**	-	Advanced Physical Chemistry HC- **Theory**	**2**	Since the concepts are skill oriented includes the applications.	100%
7.		-	Research Methodology SC- **Ability Enhancement**	**2**	To teach the work plan of research and design a methodology for the problem chosen. Student seeks predictions of events, explanations, relationships and theories for them.	100%

8.		-	Industrial chemistry SC- **Ability Enhancement**	**2**	To bridge the gap between classical chemistry and chemistry is applied in industry. On the basis of natural raw materials sources and the chemistry involved, students find it easier to study industrial inorganic and industrial organic chemistry separately.	100%
9.		-	Chemistry in Everyday life SC- **Open Elective**	**2**	To aware of the common medicines and metals used in everyday life so that control and prevent the adverse reaction from drugs	100%
10.		-	Ethics and art of scientific writing SC- **Self Study**	**2**	To Understand the research methodologies, procedures and awareness of relevant guidelines so that student can gain an adequate knowledge of art and science of writing and interpret the results of the research outcome.	100%
11.		-	Synthetic Organic Chemistry SC- **Self Study**	**2**	To correlate the basic concept, so that understand in-depth the design and synthesis of complex molecules.	100%
12.		-	Mathematics for Chemists SC-**Soft Skill**	**2**	Without some basic mathematics skills, chemistry becomes extremely difficult. Hence to explore important concepts in chemistry, basics of mathematical calculations are absolutely necessary.	100%
13.		-	Food and Pharmaceutical Analysis SC-**Soft Skill**	**2**	To familiarize sampling and analysis of various components present in the food and pharmaceutical samples	100%
14.	**Fourth**	-	Advanced spectroscopy	**2**	Since there is Molecular Symmetry and Spectroscopy in III Semester, addition of this paper able to provide a link between the basics and advanced spectroscopy in terms of analytical, organic, inorganic and physical chemistry.	100%
15.		-	Chemistry in day-to-day life SC- **Interdisciplinary**	**2**	To aware of the common drugs, medicines and metals used in everyday life so that control and prevent the adverse reactions from drugs.	100%

16.		-	Chemo informatics SC- **Ability Enhancement**	**2**	To combine the scientific working fields of chemistry, computer science and information science in the areas of topology, chemical graph theory, information retrieval and data mining in the chemical space.	100%
17.		-	Agricultural chemistry SC-**Soft Skill**	**2**	To study the chemistry and biochemistry in relation to the agricultural field. In this paper, factors such as agricultural production, the utilization of agricultural products, and environmental matters are studied and ways to improve them are developed.	100%
18.		-	Computer Applications in Chemistry SC-**Soft Skill**	**2**	To apply the basic operations of spreadsheet applications and to utilize bibliography management software while typing and downloading citations.	100%
19.		-	Analytical Clinical Biochemistry SC-**Soft Skill**	**2**	To impart knowledge of methods and techniques for biomolecules separation purification and analysis.	100%
20.		-	Mushroom technology SC- **Certificate Course**	**2**	To strengthen the promotion of mushroom cultivation by establishing a well-equipped laboratory and provide the appropriate training for the promotion of mushroom production in the country	100%

VISION AND MISSION OF THE COLLEGE

VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet**.**

MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

VISION AND MISSION OF THE DEPARTMENT

VISION:

To develop the department into a full-fledged knowledge center for learning chemistry professionally, ethically and to make students successful employed entrepreneurial.

MISSION:

1. To provide a vibrant and innovative environment for students to acquire knowledge necessary for developing themselves into qualified professionals.
2. To continuously update curriculum in tune with emerging trends with interdisciplinary approach.
3. To inculcate the spirit of innovative thinking among the students, train them to meet the challenges needs of the stakeholders and enable the learners implementing the concepts to address the real world problems.

PO No.	Programme Educational Objectives (PEOs)
PEO-1	**PROFESSIONAL DEVELOPMENT** To train the students to acquire knowledge in their chosen programme and apply professionally and ethically with responsibility towards the need of the society
PEO-2	**CORE PROFICIENCY** To expertise the students to organize, understand, apply, evaluate, and solve problems by providing hands on experience through modern tools necessary for practice.
PEO-3	**TECHNICAL ACCOMPLISHMENTS** To equip the students with the talent to interpret in core applications by building up a multi-disciplinary concept.
PEO-4	**PROFESSIONALIS**M To train the students to acquire the significance of self-discipline, communication skills, professional attitude, holistic personality development, responsibility and team work to be better entrepreneur.
PEO-5	**LEARNING ENVIRONMENT** To provide an environment for life-long learning to inculcate the importance of research, creativity, invention and leadership to become a successful entrepreneur

Mapping of Mission of the Department with Programme Educational Objectives

Mission	Programme Educational Objectives (PEOs)				
	PEOs-1	**PEOs-2**	**PEOs-3**	**PEOs-4**	**PEOs-5**
M1	*			*	
M2		*			*
M3			*	*	

PO No.	Programme Outcomes (POs) Upon completion of the Programme the student will be able -
PO-1	To impart in-depth knowledge in discipline with special emphasis on use of technology in chemical applications.
PO-2	To develop more advanced epistemological beliefs, enhanced critical thinking ability and meta cognitive skills, and an understanding of the relations among perspectives derived from interdisciplinary approach.
PO-3	To provide training in observing, formulating problems, hypothesizing, designing experiments, analyzing data, drawing conclusions, and communicating skills.
PO-4	To inculcate research culture leading to publication of review articles and research article from the projects.
PO-5	To equip the students with specialised scientific and technical approach in professional attitude towards team work, responsibility and accountability for a better career.

PSO No.	Programme Specific Outcomes PSOs Upon completion of the Programme the student will acquire -
PSO-1	Knowledge in depth in Fundamentals, Organic reaction mechanisms, Structural and Molecular Organic Chemistry, Coordination chemistry, **Bio-inorganic chemistry,**

	Quantum chemistry and group theory, Nuclear chemistry, Molecular spectroscopy and Organometallics.
PSO-2	Innovative ideas and skills on Materials Science and Pharmacology of Plant Products through interdisciplinary departments
PSO-3	The laboratory experiences include enhancing mastery of analytical, organic, inorganic and physical experiments, develops practical skills and improving team work abilities.
PSO-4	The dissertation work/internship provides training in handling research tools to write and publish review and research articles.
PSO-5	Knowledge on Separation Techniques, Advanced Spectroscopy, Synthetic Organic Chemistry and Molecular Rearrangements, Advanced Physical Chemistry, Instrumental Methods of Analysis, Good Laboratory Practices, Pharmaceutical chemistry, Renewable Energies, Green Chemistry, Industrial chemistry, Food and Pharmaceutical Analysis, Agricultural chemistry and Water remediation and conservation studies provide jobs in industries and research organizations.

Mapping of Programme Educational Objectives with Program Outcomes and Programme Specific outcomes

	Program Outcomes					**Program Specific Outcomes**				
Programme Educational Objectives	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
PEOs-1	*		*		*	*		*	*	*
PEOs-2		*	*	*	*		*	*	*	
PEOs-3			*		*	*		*	*	*
PEOs-4		*			*		*			*
PEOs-5	*			*	*				*	*

M.Sc., CHEMISTRY PROGRAMME STRUCTURE & REVISED SYLLABUS-2020-21

TABLE INDICATING DISTRIBUTION OF HARDCORE, SOFT CORE, OPEN ELECTIVES AND CREDITS ACCORDING TO CBCS SEMESTER-SCHEME

FIRST YEAR

Sl.	Subject	QP	Paper Title	Typ	L	T	P	Credit	Total

No	Code	Code		e				s	Credits
FIRST SEMESTER									
1.	A0210	55001	Fundamentals of Chemical Analysis	HC	3	0	0	3	**18**
2.	A0220	55002	Inorganic Chemistry-I	HC	3	0	0	3	
3.	A0230	55003	Stereochemistry, Reaction Mechanisms and Heterocyclic Chemistry	HC	3	0	0	3	
4.	A0240	55004	Basic Physical Chemistry	HC	3	0	0	3	
ANY TWO OF THE FOLLOWING TO BE CHOSEN									
5.	AP210	NA	Analytical Chemistry Practical-I	HC	0	0	4	2	
6.	AP220	NA	Inorganic Chemistry Practical-I	HC	0	0	4	2	
7.	AP230	NA	Organic Chemistry Practical-I	HC	0	0	4	2	
8.	AP240	NA	Physical Chemistry Practical-I	HC	0	0	4	2	
9.			Any one Ability Enhancement Courses to be chosen from the **List A**	SC	2	0	0	2	
SECOND SEMESTER									
14.	B0210	55101	Separation Techniques	HC	3	0	0	3	**20**
15.	B0220	55102	Inorganic Chemistry-II	HC	3	0	0	3	
16.	B0230	55103	Reagents in Organic Chemistry and Molecular Rearrangements	HC	3	0	0	3	
17.	B0240	55104	Principles of Physical Chemistry	HC	3	0	0	3	
ANY TWO OF THE FOLLOWING PRACTICALS TO BE CHOSEN **Note:** The practical chosen in the previous semester shall not be repeated.									
18.	BP230	NA	Organic Chemistry Practical-I	HC	0	0	4	2	
19.	BP240	NA	Physical Chemistry Practical-I	HC	0	0	4	2	
20.	BP210	NA	Analytical Chemistry Practical-I	HC	0	0	4	2	
21.	BP220	NA	Inorganic Chemistry Practical-I	HC	0	0	4	2	
22.			Any one of the Interdisciplinary courses from sister department to be chosen	SC	2	0		2	
23.			Any one of the Generic elective/Open elective courses from unrelated department to be chosen	OE	1	1	0	2	

SECOND YEAR

Sl .No	Subject Code	QP Code	Paper Title	Type	L	T	P	Credits	Total Credits
THIRD SEMESTER									
1.	C0210	55201	Instrumental Methods of Analysis	HC	3	0	0	3	
2.	C0220	55202	Molecular Symmetry and Spectroscopy	HC	3	0	0	3	
3.			Advanced Physical Chemistry	HC	3	0	0	3	

ANY TWO OF THE FOLLOWING TO BE CHOSEN **Note:** The practical chosen in the previous semesters shall not be repeated.									**21**
4.	CP330	NA	Organic Chemistry Practical-II	SC	0	0	4	2	
5.	CP340	NA	Physical Chemistry Practical-II	SC	0	0	4	2	
6.	CP310	NA	Analytical Chemistry Practical-II	SC	0	0	4	2	
7.	CP320	NA	Inorganic Chemistry Practical-II	SC	0	0	4	2	
8.			Any one Ability Enhancement Courses to be chosen from the **List B**	SC	2	0	0	2	
			Any one of the Self Study courses to be chosen from **List C**	SC	2	0	0	2	
			Any one of the Skill Based Courses to be chosen from the **List D**	SC	2	0	0	2	
			Any one of the Generic elective/Open elective courses from unrelated department to be chosen	OE	1	1	0	2	
FOURTH SEMESTER									
9.	D0210	55301	Bioinorganic Chemistry	HC	3	0	0	3	**20**
10.			Advanced Spectroscopy	HC	3	0	0	3	
11.	DP210	NA	Dissertation	SC	0	0	8	4	
ANY TWO OF THE FOLLOWING PRACTICALS TO BE CHOSEN **Note:** The practical chosen in the previous semesters shall not be repeated.									
12.	DP330	NA	Organic Chemistry Practical-II	SC	0	0	4	2	
13.	DP340	NA	Physical Chemistry Practical-II	SC	0	0	4	2	
14.	DP310	NA	Analytical Chemistry Practical-II	SC	0	0	4	2	
15.	DP320	NA	Inorganic Chemistry Practical-II	SC	0	0	4	2	
16.			Any one of the Soft-Core General Courses to be chosen from **List E**	SC	2	0	0	2	
17.			Any one of the Interdisciplinary courses from sister department to be chosen	SC	2	0	0	2	
18.			Any one of the Skill Based Courses to be chosen from the **List F**	SC	2	0	0	2	
		Total Credits (HC-48+SC-28+ OE- 04)							**79**
	HC= HARD CORE PAPER. SC= SOFT CORE PAPER. OE = OPEN ELECTIVE								

SEMESTER WISE SOFT- CORE ELECTIVE PAPERS

List A- Soft-Core Ability Enhancement Courses						
Sl. No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	First	Good Laboratory Practices (largely Practical based)	2	0	0	2
2		Chemistry in Everyday life	2	0	0	2
3		Green Chemistry	2	0	0	2

List B- Soft-Core Ability Enhancement Courses						
Sl. No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Third	Research Methodology	2	0	0	2
2		Water remediation and conservation	2	0	0	2
3		Industrial chemistry	2	0	0	2
List C- Soft-Core Self Study Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Third	Ethics and art of scientific writing	2	0	0	2
2		Synthetic Organic Chemistry	2	0	0	2
List D- Soft-Core Skill Based Courses						
S. I No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Third	Mathematics for Chemists	2	0	0	2
2		Food and Pharmaceutical Analysis	2	0	0	2
3		Chemistry of Food and Beverages	2	0	0	2

List E- Soft-Core General Courses						
Sl. No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Fourth	Photochemistry and pericyclic reaction	2	0	0	2
2		Inorganic polymers and industrial inorganic chemistry	2	0	0	2
3		Chemical kinetics	2	0	0	2
4		Solid state chemistry and semiconductors; bio-physical chemistry	2	0	0	2
5		Chemistry in day-to-day life	2	0	0	2
6		Chemo informatics	2	0	0	2
List F- Soft-Core Skill Based Courses						
Sl. No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Fourth	Chemo informatics	2	0	0	2
2		Agricultural chemistry	2	0	0	2
3		Computer Applications in Chemistry	2	0	0	2
4		Analytical Clinical Biochemistry	2	0	0	2

SEMESTER WISE INTERDISCPLINARY COURSES OFFERED TO SISTER DEPARTMENT

Sl. No	**Semester**	**Title of the paper**	**L**	**T**	**P**	**Credits**
1	Second	Chemistry of food and beverages	1	1	0	2
2	Fourth	Chemistry in day-to-day life	1	1	0	2

SEMESTER WISE GENERIC/OPEN ELECTIVE COURSES OFFERED TO UNRELATED DEPARTMENT

Sl. No	Semester	Title of the paper	L	T	P	Credits
1	Second	Water remediation and conservation	2	0	0	2
2	Third	Chemistry in Everyday life	2	0	0	2

Value added courses (Add on courses)

Sl. No	Semester	Title of the paper	L	T	P	Credits
1	Second	Bio fertilizers (Practical based course)	2	0	0	2
2	Fourth	Mushroom technology	2	0	0	2

FIRST SEMESTER

Course Title	**FUNDAMENTALS OF CHEMICAL ANALYSIS**								
Course Type	**Hard Core**-Theory		**Total hours**	48	**Hours/Week**	03	**Credits**	03	
Course Code	**A0210**	**Evaluation**	**Internal**	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To introduce some important analytical terms.
CO-2	Understand the technique in sampling
CO-3	Calculations of statistical parameters such as errors, accuracy and precision, sensitivity and others
CO-4	To understand the standardization and calibration of analytical methods
CO-5	Theory behind acid-base, precipitation, redox and complexometric titration
CO-6	Quantitative application of titration in the real samples

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Apply the analytical methods and techniques.	PSO-1	Remember, Understand, Apply and Analyse
CLO-2	Finding errors and treatment of analytical data	PSO-1	Apply, Analyse and Evaluate
CLO-3	Designing and Implementing the sampling plan	PSO-1	Remember, Apply, and Analyse
CLO-4	Select, calculate and apply the quantitative analysis of organic and inorganic compounds	PSO-1	Understand, Apply and Analyse
CLO-5	Differentiate the role of solvent in acid-base titrations	PSO-1	Understand, Apply and Analyse
CLO-6	Analyse the titrations based on acid-base, precipitation and complex metric reactions	PSO-1	Understand, Apply, Analyse and Evaluate

COURSE CONTENTS:

Module-1		16 hrs
1.1	**Language of analytical chemistry** - Analysis, determination and measurement. Classifying analytical techniques. Selecting an analytical method - accuracy, precision, sensitivity, selectivity, robustness and ruggedness. Scale of operation, equipment, time and cost. Making the final choice	**04 hrs**
1.2	**Errors and treatment of analytical data:** Limitations of analytical methods – Error: determinate and indeterminate errors, minimization of errors. Accuracy and precision, distribution of random errors, the normal error curve. Statistical treatment of finite samples -measures of central tendency and variability, mean, median, range, standard deviation and variance. Student's t-test, confidence interval of mean. Testing for significance - comparison of two means and two standard deviations. Comparison of an experimental mean and a true mean. Criteria for the rejection of an observation - Q-test. Propagation of errors: determinate errors and indeterminate errors.	**08hrs**
1.3	**Standardization and calibration**: Comparison with standards - direct comparison and titrations. External standard calibration - the least squares methods, regression equation and regression coefficient. Internal standard methods and standard-addition methods. Figures of merit of analytical methods - sensitivity and detection limit, linear dynamic range.	**04 hrs**

	Key word: Errors, standardization, Analytical calibration	

Module-2		**16 hrs**
2.1	**Obtaining and preparing samples for analysis**: Importance of sampling, designing a sample plan-random, judgement, systematic- judgment, stratified and convenience sampling. Type of sample to collect - grab and composite samples. *Insitu* sampling. Size of sample and number of samples. Implementing the sampling plan - solutions, gases and solids. Bringing solid samples into solution - digestion and decomposing.	**05 hrs**
2.2	**Quantitative applications** – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity and free CO_2 in water and waste waters, nitrogen, sulphur ammonium salts, nitrates and nitrites, carbonates and bicarbonates. Organic analysis - functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl and carbonyl. Air pollutants like SO_2. Quantitative calculations. Characterization applications - equivalent weights and equilibrium constants.	**06hrs**
2.3	**Titrimetric analysis:** An overview of titrimetry. Principles of titrimetric analysis. Role of solvent in acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications -determination of Carboxylic acids, phenols and amines.	**05 hrs**
	Key word: Sampling, titration-application	

Module-3		**16 hrs**
3.1	**Acid-base titrations:** Titration curves. Titrations based on acid-base reactions - titration curves for strong acid and strong base, weak acid and strong base and weak base and strong acid titrations. Selecting and evaluating the end point. Finding the end point by visual indicators, monitoring *p*H and temperature.	**03 hrs**
3.2	**Precipitation titrations:** Titration curves, feasibility of precipitation titrations, factors affecting shape - titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan's methods, typical applications.	**03 hrs**
3.3	**Complexometric titrations:** Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA - acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves - completeness of reaction, indicators for EDTA titrations - theory of common indicators, titration methods employing EDTA - direct, back and displacement titrations, indirect determinations, titration of mixtures.	**05 hrs**
3.4	**Redox titration:** Balancing redox equations, calculation of the equilibrium constant of redox reactions, calculating titration curves, detection of end point, visual indicators and potentiometric end point detection. Quantitative applications - adjusting the analyte's oxidation state, selecting and standardizing a titrant. Inorganic analysis - chlorine residuals, dissolved oxygen in water, water in non-aqueous solvents. Organic analysis - chemical oxygen demand (COD) in natural and waste waters, titrations of mercaptans and ascorbic acid with I_3 and titration of organic compounds	**05 hrs**

	using periodate.	
	Key words: Acid-base, precipitation, complexometric and redox titration	

30% Theory and 70% Problems

References:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicati on
1	Analytical chemistry	G. D. Christian	Wiley publication	6^{th}	2013
2	Fundamentals of Analytical Chemistry	Skoog, West, Holler, Crouch	Saunders College Publishing, New York,	8^{th}	2004
3	Modern Analytical chemistry	David Harvey	Mcgraw Hill	1^{st}	2000
4	Analytical Chemistry 2.0	David Harvey	McGraw-Hill Companies, Depauw	1^{st}	2018
5	Quantitative Analysis	R.A. Day and A.L. Underwood,	Prentice Hall, Inc. New Delhi,	6/E, 6^{th}	2008
6	Calculations in Chemistry	John olusina obimakinde, Samuel Oluwaseun Obimakinde	IK international publishing house	1^{st}	2014

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Course Title	INORGANIC CHEMISTRY-I							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand principles of VSEPR model and molecular orbital theory
CO-2	Understand the delocalized π-bonding of molecular orbital.
CO-3	Understanding the importance of organometallic chemistry for modern efficient and selective synthesis
CO-4	Demonstrate and understanding of the basic principles of acid – base chemistry and nonaqueous solvents
CO-5	Construction of molecular orbital diagram involving pi- bonding

MAPPING CLO'S WITH PSO's AND CD's

CLO	Course Learning Outcomes	PSOs	Cognitive Leve
CLO-1	Predict the stable geometry of inorganic molecules	PSO-1	Understand, Apply Analyse
CLO-2	Calculation of metal-metal bondings.	PSO-1	Analyse and Evaluate
CLO-3	Construction of molecular orbiral diagram involving pi- bonding	PSO-1	Understand, Apply
CLO-4	Characteristics of Bronsted acids and applications of acid-base chemistry.	PSO-1	Remember, Understand
CLO-5	Predicting the shape Structure and bond properties of polyatomic molecules using VSEPR model	PSO-1	Understand, Analy Apply

COURSE CONTENTS

MODULE-1
16hrs

1.1	**Modern concept of acids and bases**: Lux-Flood and Usanovich concepts, solvent system and leveling effect. Hard-Soft Acids and Bases, Classification and Theoretical backgrounds.	**4hrs**
1.2	**Non-aqueous solvents**: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties) protic solvents (anhydrous H_2SO_4, HF and glacial acetic acid) aprotic solvents (liquid SO_2, BrF_3 and N_2O_4). Solutions of metals in liquid ammonia, hydrated electron. Super acids and super bases. Heterogeneous acid base reactions.	**4hrs**
1.3	**Ionic liquids:** Molten salt solvent systems, Ionic liquids at ambient temperature, Reactions in and applications of molten salt/ionic liquid media.	**4hrs**
1.4	**Supercritical fluids:** Properties of supercritical fluids and their uses as solvents. Supercritical fluids as media for inorganic chemistry ***Keywords: HSAB concept, Ionic liquids***.	**4hrs**

MODULE –II **16 hrs**		
2.1	**Fundamental concepts:** Introduction 16 and 18 electron rule Classification of organometallic compounds by bond type, nomenclature, the effective atomic number rule, complexes that disobey the EAN rule, common reactions of organometallic compounds.	**4hrs**
2.2	**Organometallics of transition metals:** Preparation, bonding and structures of nickel, cobalt, iron and manganese carbonyls. Preparation and structures of metal nitrosyls in organometallics.	**4hrs**
2.3	**Ferrocene:** Preparation, structure and bonding.	**3hrs**
2.4	**Metals containing alkene, alkyne, arene and allyl ligands**: preparation, structure and Bonding. The isolobal principles. ***Keywords: Metal carbonyls, EAN rule, Metallocenes***	**5hrs**
MODULE-3 **16 hrs**		
3.1	**Structures and energetics of inorganic molecules**: Introduction, Energetics of hybridization.VSEPR model for explaining structure of AB_2, AB_2E, AB_3E, AB_2E_2, ABE_3, AB_2E_3, AB_4E_2, $AB_5E$and AB_6 molecules.	**5hrs**
3.2	**M.O. treatment** of homonuclear (Li_2, Be_2, B_2, C_2, N_2, O_2, F_2) and heteronuclear diatomic molecules (CO, NO, HCl).M.O. treatment involving delocalized π-bonding (CO_3^{2-} , NO_3^- , $NO_2^-$and N_3^-), M.O. correlation diagrams (Walsh) for triatomic molecules.	**5hrs**
3.3	**Inorganic chains, rings, cages and clusters** Diborane and its reactions, polyhedral boranes (preparation, properties, structure and bonding). Wade's rules, carboranes and metallocarboranes. Borazines, Phosphazenes, S-N compounds. Metal Clusters- $Re_2Cl_8^{2-}$, $Mo_6Br_8^{4+}$, Evidences and factors favoring of M-M bonding, Wade's-Mingo's- Lauher rules, bi, tri, tetra, penta and hexa nuclear metal clusters. ***Keywords: Inorganic cages, VSEPR***	**6hrs**

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
2	Basic Concepts of Inorganic Chemistry	D.N. Singh	Pearson Education,	2nd	2010
3	Inorganic chemistry	Mark Weller, TinaOverton	Oxford Uiversity press	6th	2010
4	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
5	Advance Inorganic Chemistry	F. Albert Cotton, Geoffrey, Wilkinson	John Wiley and Sons	6th	2004
6	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004
7	Concise Inorganic Chemistry	J.D. Lee	Blackwell Science Ltd.,	5th	2003

8	Inorganic Chemistry	Catherine E. *Housecroft* And G. Sharpe Alan	Pearson Education	2nd	2003	
9	Basic Organometallic Chemistry	B.D. Gupta and A.J. Elias	Universities Press	1st	2010	
10	Concise Coordination Chemistry	R.Gopalan and V.Ramalingam.				
11	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013	
12	Organometallic Chemistry	R.C. Mehrothra and A. Singh	New Age International	2nd	2006	
13	The Organometallic Chemistry of	Robert H. Crabtree	Wiley Interscience,	4th	2005	
14	Inorganic Chemistry	D.F. Shriver, P.W. Atkins	Oxford University Press	2nd	1994	

Suggested readings

1	Inorganic Chemistry	James E. Huheey, Ellen A.	Pearson Education	4th	2013
2	Basic Concepts of	D.N. Singh	Pearson Education,	2nd	2010
3	Inorganic chemistry	Mark Weller, TinaOverton	Oxford Uiversity	6th	2010
4	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
5	Advance Inorganic	F. Albert Cotton, Geoffrey,	John Wiley and Sons	6th	2004
6	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004
7	Basic Organometallic Chemistry	B.D. Gupta and A.J. Elias	Universities Press	1st	2010
8	Concise Coordination Chemistry	R.Gopalan and V.Ramalingam.			
9	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
10	Organometallic Chemistry	R.C. Mehrothra and A. Singh	New Age International	2nd	2006
11	The Organometallic Chemistry of transition metals	Robert H. Crabtree	Wiley Interscience,	4th	2005

Course Title	**STEREOCHEMISTRY, REACTION MECHANISMS AND HETEROCYCLIC CHEMISTRY**							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code	A0230	Evaluation	Internal	C1+C2 = 15+15			30 Marks	10

			External	Duration	03Hrs	C3	70 Marks	0

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To Identify and differentiate chirality at centers, axis, planes and determine the absolute configuration
CO-2	To know the stability of different Conformations
CO-3	To convey the role of temperature, solvents, and catalysts in organic reactions
CO-4	Elucidate reaction mechanisms and Intermediates formed
CO-5	To understand the preparation and applications of Heterocyclic compounds

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	R/S, E/Z - prediction for molecules	PSO-1	Apply Analyse And Evaluate
CLO-2	Determine Stereoselectivity of various organic transformations	PSO-1	Apply and Analyse
CLO-3	Evaluate the stability of various conformers of acyclic and cyclic systems using steric, electronic and stereoelectronic effects.	PSO-1	Understand, Apply and Analyse
CLO-4	Envisage the organic reaction mechanism and product identification	PSO-1	Understand and Apply
CLO-5	Formation and Identification of Reaction Intermediates.	PSO-1	Understand and Apply
CLO-6	Preparation and applications of various heterocyclic compounds.	PSO-1	Understand

COURSE CONTENTS

Module 1		**16hrs**
1.1	**Stereoisomerism:** Projection formulae [Fly wedge, Fischer, Newman and Saw horse], enantiomers, diasteroisomers, racemic mixture and their resolution, configurational notations of simple molecules, *DL* and *RS* configurational notations.	**3 hrs**
1.2	**Stereoselectivity:** Stereoselective reactions, diasteroselective reactions, stereospecific reactions, regioselective and regiospecific reactions.	**2 hrs**
1.3	**Optical isomerism:** Conditions for optical isomerism, optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls, criteria for optical purity.	**2 hrs**
1.4	**Geometrical isomerism:** Due to C=C, C=N and N=N bonds, E, Z conventions, determination of configuration by physical and chemical methods.	**2 hrs**
1.5	**Conformational isomerism:** Elementary account of conformational equilibria of ethane, butane and cyclohexane.	**2 hrs**

1.6	**Conformational analysis:** Conformation of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives and decalins. Conformational analysis of 1,2, 1,3, and 1,4-disubstitutedcyclohexane derivatives and *D*-Glucose, Effect of conformation on the course/rate of reactions. ***Key words- Confirmational and Constitutional isomers***	**5 hrs**
Module 2		**16 hrs**
2.1	**Structure and reactivity:** Acids and bases, Structural effect on acidity and basicity, hydrogen bonding resonance, inductive and hyper conjugation effects.	**2hrs**
2.2	**Basics of organic reactions:** Meaning and importance of reaction mechanism, classification and examples for each class.	**2hrs**
2.3	**Substitution reactions:** Mechanism of nucleophilic substitution reactions – Kinetics, mechanism and stereo chemical factors affecting the rate of S_N^1, S_N^2, S_N^i reactions, neighbouring group participation.	**4hrs**
2.4	**Aromatic nucleophilic substitution**: S_N^1, S_N^2 and benzyne mechanism, Bucherer reaction. Aromatic electrophilic substitution: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier-Haack, Von-Richter reaction.	**4hrs**
2.5	**Reaction Intermediates:** Formation, structure, stability, detection and reactions of carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrenes, and arynes. ***Key words- Substitution reaction mechanisms and reactive intermediates***	**4hrs**
Module 3		**16 hrs**
	Heterocyclic chemistry: Nomenclature of heterocyclic systems, Structure, reactivity, synthesis and reactions (minimum three) of furan, pyrrole, thiophene, indole, pyridine, quinoline, isoquinoline, pyrazole, imidazole, pyrone, coumarin, chromones, pyrimidines and purines. ***Key words- Heterocyclic compounds, Preparation, applications***	**16 hrs**

20% Problems and 80% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Organic Chemistry	Robert. N. Boyd and Robert Thornton Morrison	Pearson	6th	2016
2.	Stereochemistry: Confomation and Mechanism	Kalsi P. S	New Age International Private Limited	9th	2017
3.	Stereochemistry of Organic Compounds: Principles and Applications	D. Nasipuri	New Age International Private Limited	3rd	2018
4.	Stereochemistry of Organic Compounds	E.L. Eliel and S.H. Wilen	John Wiley and Sons, New York.	-	1994

5.	A Guide Book to Mechanism in Organic Chemistry	Petersykes	Pearson	6th	2003
6.	Advanced Organic Chemistry	J. March	Wiley	7th	2013
7.	Organic Reaction Mechanism.	R.K. Bansal,	by Wiley Eastern Limited, New Delhi,		1993
8.	Organic Chemistry	Marye Anne Fox, James K. Whitesell	Jones & Bartlett Learning	3rd illustrated	2004
9.	Heterocyclic Chemistry	Raj K. Bansal	New Age International	3rd	1999
10.	Heterocyclic Chemistry	Joule & Smith	Wiley-Blackwell	5th	2013
11.	Principles of Modern Heterocyclic Chemistry	L.A. Pacquette	Benjamin-Cummings	-	1978
12.	Comprehensive Heterocyclic Chemistry	Kartritzky series	Elsevier	-	2008
RECOMMENDED BOOKS					
1	Introduction to Stereochemistry	Kurt Mislow	Dover Publications	6th	2002
2	Principles of Organic Synthesis,	ROC Norman and J. M. Coxon	CRC Press	6th	1996.
3	Advanced Organic Chemistry	F. A. Carey and R. J. Sundberg,	Plenum	-	1990
4	Basic Principles of Heterocyclic Chemistry	Alan R. Katritzky and J.M. Lagowski	Elsevier	-	1968

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Course Title	**BASIC PHYSICAL CHEMISTRY**							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Correlating the concepts of kinetics through demonstration of experiments.
CO-2	Explanation of different thermodynamic variables by solving the problems.
CO-3	Illustrate the different numerical concepts involved in electrochemistry.
CO-4	Understand the role of thermodynamic cycles, availability and irreversibility.
CO-5	To state the basis for the the collision model of chemical kinetics.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Understand the role of internal energy, enthalphy, entropy and thermodynamic properties.	PSO-1	Understand, Apply and Analyse
CLO-2	Recognise and understand the different forms of pure substances.	PSO-1	Apply and understand
CLO-3	Identify and use units and notations in thermodynamics**.**	PSO-1	Apply, Analyse and Evaluate
CLO-4	To describe how rate laws are determined.	PSO-1	Understand, Apply and evaluate
CLO-5	To describe an activation complex or transition state.	PSO-1	Understand and Analyse
CLO-6	To identify the compounds being oxidized and reduced.	PSO-1	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	**Concepts of entropy and free energy:** Entropy as a measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies (Definition and equation).. Variation of free energy with temperature and pressure. Maxwell's relations, Nernst heat theorem .Third law of thermodynamics - calculation of absolute entropies.	**5hrs**
1.2	**Partial molar properties:** Partial molar volumes and their determination by intercept method and density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs Duhem equation. Derivation of Duhem-Margules equation.	**7hrs**
1.3	**Fugacity:** Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity co-efficient by vapor pressure, depression in freezing point and solubility measurements by electrical methods ***Key words- Entropy, Free energy, Temperature, Activity.***	**4hrs**
Module-2		**16 hrs**
2.1	**Kinetics of complex reactions**: Parallel, consecutive and reversible reactions. Determination of order of reaction. Arrhenius equation, energy of activation and its experimental determination. Potential energy surface, theoretical calculation of energy of activation. Simple collision theory - mechanism of bimolecular reaction. Lindeman's theory, Hinshelwood's theory for	**10hrs**

	unimolecular reaction. Activated complex theory of reaction rate, Kinetics of reactions in solution - Salt effects, effect of dielectric constant (single sphere and double sphere model), effect of pressure, volume and entropy change on reaction rates. Cage effect with an examples. Kinetics of heterogeneous reactions - Langmuir's theory of unimolecular and bimolecular surface reactions.	
2.2	**Fast reactions:** Study of kinetics by flow techniques, equation for contact time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure jump methods, flash photolysis, pulse radiolysis and shock tube method. ***Key words- Kinetics , Rateequation, Collision, Theories.***	**6hrs**
Module – 3		**16 hrs**
3.1	**Electrochemistry:** Arrhenius theory of strong and weak electrolytes and its limitations, Debye-Huckel theory of strong electrolytes, Debye Huckel-Onsager equation, Debye-Huckel limiting equation for activity co-efficients, Debye-Huckel equation for appreciable concentrations. Liquid junction potential and its determination. , Transport Number - Determination of transport number by Hittorf method and E.M.F method. True and apparent transport numbers. Abnormal transport numbers, effect of temperature and concentration on transport number.	**7hrs**
3.2	**Irreversible electrode process:** Introduction, reversible and irreversible electrodes, Potential energy surface, theoretical calculation of energy of activation. Reversible and irreversible cells. Polarization, over voltage - ohmic, concentration, activation, experimental determination of over voltage. Hydrogen and Oxygen over voltage. Effect of temperature, current density and *p*H on over voltage. Equations for concentration over potential, diffusion current – stationary current, potential curves, thickness of diffusion layer, diffusion controlled current – potential curves at a dropping mercury electrode, polarography, half wave potential, application in qualitative and quantitative analysis. Butler-Volmer equation, Tafel equation. **Energetics of cell reactions:** Introduction, galvanic and electrolytic cells, schematic representation of cells. Faradays's law, mass transfer in cells. Batteries: Classification, characteristics, primary, secondary and lithium batteries, fuel cells. ***Key words: Polarisation, overvoltage, cell reactions, over potential.*** Key words	**9hrs**

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Thermodynamics for Chemists	S. Glasstone	Read books	--	2007
2	Chemical Kinetics	K.J. Laidler	Pearson	Third	2003
3	Kinetics and Mechanism of Chemical	J. Rajaram and J.C. Kuriacose	Macmillan Publishers	Reprint	2000
RECOMMENDED BOOKS					
1	Physical Chemistry	P.W. Atkins	ELBS, edition,	fourth	1990

			Oxford		
2	Physical Chemistry	Arun Bhal and B.S. Bhal	S. Chand	13th	1963

FIRST SEMESTER PRACTICALS

Course Title	**ANALYTICAL CHEMISTRY PRACTICALS-I**								
Course Type	Hard Core-Practical		Total Hours	96	Hours/Week		04	Credits	**02**
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	03Hrs	C3		70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Quantitative analysis of water samples by EDTA titrations
CO-2	Determination of stoichiometry of certain basic reactions
CO-3	Potentiometric and conductometric determination
CO-4	Chromatographic determination and detection
CO-5	Absorption and emission method of analysis

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Quantitative analysis using precipitation titration	PSO-3	Apply Analyse and Evaluate
CLO-2	Quantitative analysis using spectrophotometric method	PSO-3	Apply, Analyse and Evaluate
CLO-3	Quantitative analysis by complexometric titration	PSO-3	Apply, Analyse and Evaluate
CLO-4	Quantitative analysis by acid base titration	PSO-3	Apply Analyse and Evaluate
CLO-5	Quantitative analysis by flame photometric method	PSO-3	Apply Analyse and Evaluate

COURSE CONTENTS:

Part I	
	1. Determination of total acidity of vinegar and wines by acid-base titration. 2. Determination of purity of a commercial boric acid sample, and Na_2CO_3 content of washing soda. 3. Determination of replaceable hydrogen and relative molecular mass of a weak organic acid by titration with NaOH. 4. Periodate determination of ethylene glycol and glycerol (Malprade reaction). 5. Determination of carbonate and bicarbonate in a mixture by *p*H-

	metric titration and comparison with visual acid-base titration 6. Determination of the *p*H of hair shampoos and *p*H determination of an unknown soda ash. 7. Analysis of water/waste water for acidity by visual, *p*H metric and conductometric titrations. 8. Analysis of water/waste water for alkalinity by visual, *p*H metric and conductometric titrations. 9. Determination of ammonia in house-hold cleaners by visual and conductometric titration. 10. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid. 11. Spectrophotometric determination of creatinine and phosphorus in urine. 12. Flame emission spectrometric determination of sodium and potassium in river/lake water
Part II	
	1. Determination of percentage of chloride in a sample by precipitation titration - Mohr, Volhard and Fajan's methods. 2. Determination of silver in an alloy and Na_2CO_3 in soda ash by Volhard method. 3. Determination of total hardness, calcium and magnesium hardness and carbonate and bicarbonate hardness of water by complexation titration using EDTA. 4. Determination of calcium in calcium gluconate/calcium carbonate tablets/injections and of calcium in milk powder by EDTA titration. 5. Analysis of commercial hypochlorite and peroxide solution by iodometric titration. 6. Determination of copper in an ore/an alloy by iodometry and tin in stibnite by iodimetry. 7. Determination of ascorbic acid in vitamin C tablets by titrations with $KBrO_3$ and of vitamin C in citrus fruit juice by iodimetric titration. 8. Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate. 9. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate. 10. Cation exchange chromatographic separation of cadmium and zinc and their estimation by EDTA titration. 11. Separation and determination of chloride and bromide on an anion exchanger. 12. Thin layer chromatographic separation of amino acids.

100% practical

References

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Analytical chemistry	G. D. Christian	Wiley publication	6th	2013
2	Fundamentals of Analytical Chemistry	Skoog, West, Holler, Crouch	Saunders College Publishing, New York,	8th	2004
3	Modern Analytical chemistry	David Harvey	Mcgraw Hill	1st	2000
4	Analytical Chemistry 2.0	David Harvey	McGraw-Hill	1st	2018

			Companies, Depauw		
5	Quantitative Analysis	R.A. Day and A.L. Underwood,	Prentice Hall, Inc. New Delhi,	6/E, 6th	2008
6	Vogel's Textbook of Quantitative Chemical Analysis	J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas	Pearson Education Pvt. Ltd., New Delhi	6th Third Indian Reprint,	2003.
7	Instrumental methods of chemical analysis	G. R. Chatwal, S. K. Anand	malaya publishing House,	5th	2002.
8	Fundamental of Analytical Chemistry	D.A. Skoog, D.M. West, Holler and Crouch	Saunders College Publishing, New York,	8th edition,	2005
9	Instant Notes of Analytical Chemistry by	Kealey and Haines,	va Books Pvt. Ltd.,		2002.
10	Principles and Practice of Analytical Chemistry	by F. W. Fifield and Kealey,	Blackwell Sci., Ltd. Malden, USA,	5th	2000
11	Principles of instrumental analysis	Holler, crouch and Skoog	Cengage Learning	6th	2007
12	Biochemical analysis	Irwin H Segel	Wiley	2nd	2004
13	Spectroscopy	H. Kaur`	Pragathi prakashan	11th	2016
14	Instrumental Methods of Analysis	Supriya S. Mahajan	Popular Prakashan Private Ltd	1st	2010
15	Analytical Chemistry	S. M. Khopkar	New age international publishers	1st	2013
16	Elements of Spectroscopy	Guptha, Kumar, Sharma	Pragati Edition	28th	2016
17	Calculations in Chemistry	John olusina obimakinde, Samuel Oluwaseun obimakinde	IK international publishing house	1st Edition	2014

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Course Title	**INORGANIC CHEMISTRY PRACTICALS-I**								
Course Type	Hard Core-Practical		Total Hours	96	Hours/Week	04	Credits	**02**	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To impart advanced knowledge on the classification and further analysis of mixture of metal to ions qualitatively.
CO-2	identify individual ions present in water and mixture of salt and the chemistry behind it
CO-3	To acquire knowledge of laboratory techniques, inorganic synthesis and characterization.
CO-4	To impart the knowledge about redox, complexometric and precipitation reactions.
CO-5	Quantitative analysis of metal ions in alloy/mixture and Estimation of various ions by titrimetry and spectrophotometric methods.

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	**Course Learning Outcome**	PSOs Addressed	Cognitive Level
CLO-1	Ensures the students to understand, acquire knowledge and have hands on experience in multistep inorganic compound synthesis and analysis by using spectroscopic techniques. Separation techniques.	PSO-3	Analyze, Apply Evaluate
CLO-2	Gravimetric analysis	PSO-3	Analyze, Apply Evaluate
CLO-3	Laboratory techniques.	PSO-3	Analyze, Apply Evaluate
CLO-4	To impart the knowledge about redox, complexometric and precipitation reactions.	PSO-3	Analyze, Apply Evaluate
CLO-5	Spectrophotometric determinations	PSO-3	Analyze, Apply Evaluate

PART – I

1. Determination of iron in hematite using cerium(IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Quantitative analysis of copper-nickel in alloy/mixture:
   i. Copper volumetrically using KIO_3. ii. Nickel gravimetrically using DMG
5. Determination of lead and tin in a mixture: Analysis of solder using EDTA titration.
6. Quantitative analysis of chloride and iodide in a mixture:
   i. Iodide volumetrically using KIO_3 . ii. Total halide gravimetrically
7. Gravimetric analysis of molybdenum with 8-hydroxyquinoline.
8. Spectrophotometric determinations of:
   a. Titanium using hydrogen peroxide. b. Chromium using diphenyl carbazide in industrial effluents
   c. Iron using thiocyanate/1,10-phenanthroline method in commercial samples
   d. Nickel using dimethylglyoxime in steel solution
10. Quantitative estimation of copper(II), calcium(II) and chloride in a mixture.
11. Circular paper chromatographic separation of: (Demonstration)
    a. Iron and nickel. b. Copper and nickel

PART – II

Semi micro qualitative analysis of mixtures containing **TWO** anions and **TWO** cations (excluding sodium, potassium and ammonium cations) and **ONE** of the following less common cations: W, Mo, Ce, Ti, Zr, V, and Li.

REFERANCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	A Text Book of Quantitative Inorganic Analysis	A.I. Vogel	ELBS	3rd	
2	Vogel's Text Book of Quantitative Chemical Analysis	J.Mendham,R.C. Denney, J.D. Barnes and M.J.K. Thomas	Pearson Education Pvt. Ltd	6th	2003
3	Spectrophotometric Determination of Elements	Z. Marczenko.	Ellis Horwood	-	1976
4	Vogel's Qualitative Inorganic Analysis	– Svelha.	Pearson Education	**7th**	2008
5	Quantitative Chemical Analysis	Daniel C. Harris,		7th	2006
6	Practical Inorganic chemistry	Gurdeep Raj	GOEL Publishing house	26th	2015
7	Quantitative Analysis	R.A. Day and	Prentice Hall, Inc. New Delhi.	6th	1993

Course Title	**ORGANIC CHEMISTRY PRACTICALS-I**								
Course Type	Hard Core- Theory		Total Hours	**96**	Hours/Week	04	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

Course Objectives:

CO No.	**Course Objectives**
CO-1	To understand the concept of oxidation and reduction in organic reactions
CO-2	To understand the concepts of reaction mechanism and its applications
CO-3	To Identify suitable reagent for various chemical conversion
CO-4	Develop basic skills for the multi-step synthesis of organic compounds
CO-5	To Practice identification and separation of organic Mixtures.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	**Course Learning Outcomes**	**PSOs Addressed**	**Cognitive Level**
CLO-1	The ability to apply reagent knowledge Practically	**PSO-3**	Understand
CLO-2	Understanding the solution of problems related to the synthesis of organic target molecules	**PSO-3**	Apply and Analyse
CLO-3	Practical skills in handling organic chemistry reactions	**PSO-3**	Apply
CLO-4	Evaluate the risks associated with an experiment	**PSO3**	Analyse and

COURSE CONTENTS

PART – I		**16hrs**
1. 1	Preparation of *p*-nitro aniline from acetanilide.	
1.2	Preparation of n-butyl bromide from n-butanol.	
1.3	Preparation of *p*-nitroiodobenzene from paranitroaniline.	
1.4	Preparation of aniline from nitrobenzene.	
1.5	Preparation of β-*D*-Glucose Penta acetate.	
1.6	Preparation of Phenoxy acetic acid	
1.7	Preparation of cyclohexanone from cyclohexanol.	
1.8	Preparation of chalcone.	
1.9	Preparation of *S*-Benzylthiuronium chloride.	
1.10	Condensation of anthracene and maleic anhydride (Diels-Alder reaction).	
Part 2		**16 hrs**
2.1	**Qualitative analysis:** Separation of binary mixtures, identification of functional groups and Preparation of suitable solid derivatives. ***Key words- Organic Preparation, Binary Mixture Analysis***	**9hrs**

60% Problems (in the form of predicting products) and 40% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Comprehensive practical organic chemistry	V. K. Ahluwalia and Renu Agarwal	Universities Press	-	2001
2.	An Introduction to Practical Organic Chemistry	Caroline Frances Cornwallis	BiblioBazaar	-	2009
3.	Advanced Practical Organic Chemistry	By John Leonard, Barry Lygo, Garry Procter	Stanley Thrones Publishing	Second Edition	1994
4.	Manual of Organic Chemistry	Dey and Seetharaman	Allied Publishers,	-	1957
5.	Laboratory Manual of Organic Chemistry	R.K. Bansal	New Age International (P) Ltd. London	3rd edition	1996.
6.	A Text Book of Practical Organic Chemistry by Vol.III	A.I. Vogel,	Longman Scientific & Technical	-	1989
RECOMMENDED BOOKS					
1.	Practical Organic Chemistry	Mann & Saunders	Orient Longman	4th edition	2004
2.	Semi micro Qualitative Organic Analysis	Cheronis, Entrikin and Hodnet.	R.E. Krieger Publishing Company,	3, reprint	1983

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Course Title	**PHYSICAL CHEMISTRY PRACTICALS-I**								
Course Type	Hard Core-Theory		Total Hours	48	Hours/Week	04	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To demonstrate an ability to conduct experiments in the above sub-disciplines with mastery of appropriate techniques and proficiency using core chemical instrumentation and modeling methods
CO-2	To develop skills in quantitative modeling of static and dynamic chemical systems.
CO-3	To develop laboratory competence in relating chemical structure to spectroscopic

	phenomena
CO-4	To demonstrate the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions
CO-5	To demonstrate broad knowledge of descriptive Chemistry

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Think critically and analyze chemical problems.	PSO-3	Understand, Apply and Analyse
CLO-2	Present scientific and technical information resulting from laboratory experimentation in both written and oral formats	PSO-3	Apply and understand
CLO-3	Work effectively and safely in a laboratory environment.	PSO-3	Apply, Analyse and Evaluate
CLO-4	Use technologies/instrumentation to gather and analyze data.	PSO-3	Understand, Apply and evaluate
CLO-5	Work in teams as well as independently	PSO-3	Understand and Analyse
CLO-6	Apply modern methods of analysis to chemical systems in a laboratory setting	PSO-3	Analyse and understand

COURSE CONTENTS

PART – I		
1. 1	Study the kinetics of hydrolysis of an ester using HCl/H_2SO_4 at two different temperatures and concentrations, determination of rate constants and energy of activation.	
1. 2	Study the kinetics of reaction between $K_2S_2O_8$ and KI, first order reaction, determination of rate constant and *E*a.	
1.3	Conductometric titration of a mixture of HCl and $ClCH_2COOH$ against NaOH.	
1.4	Potentiometric titration of KI against $KMnO_4$ solution.	
1.5	Determination of dissociation constant of weak acid by potentiometric method.	
1.6	Potentiometric titration of $AgNO_3$ against KBr.	
1.7	Verification of Beer's law and calculation of molar extinction coefficient for $CuSO_4$	
1.8	Spectrophotometric titration of $FeSO_4$ against $K_2Cr_2O_7$.	
1.9	Determination of heat of solution of Organic acid by variable temperature method.	
1.10	Kinetics of Photo degradation of indigo carmine (IC) using ZnO as Photo catalyst and study the effect of [ZnO] and [IC] on the rate of photo degradation.	
1.11	Potentiometric titration of KI against $KMnO_4$ solution.	

1.12	Conductometric titration of oxalic acid against NaOH and NH_4OH	
1.13	Potentiometric titration of $AgNO_3$ against KBr.	
1.14	Study of kinetics of reaction between CAT and indigo carmine spectrophotometrically and determination of rate constant.	
1.15	To Study the kinetics of reaction between acetone and iodine – determination of order of reaction with respect to iodine and acetone.	

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Practical Physical Chemistry	-	-	-	-
2	Experimental Physical Chemistry	-	-	-	-
3	Experiments in Physical Chemistry	Yadav	Geol Publishing House	-	-
RECOMMENDED BOOKS					
1	Experiments in Chemistry	D.V. Jahagirdar	Himalaya Publishing House	-	-
2	Experimental Physical Chemistry	R.C. Das and B. Behera	Tata Mc Graw Hill	-	-

SECOND SEMESTER

Course Title	SEPARATION TECHNIQUES							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code	B0210	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand the theory behind the chromatographic separations
CO-2	Separation based on the nature of the stationary and mobile phase
CO-3	Solvent extraction for preparative organic chemistry
CO-4	Advantages of the solid phase micro extraction over the solvent extraction
CO-5	Electrophoretic methods of separation based on the interim charge associated with bimolecular system

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Chromatographic separation-mathematical equations	PSO-5	Remember, Understand, Apply , Analyse and evaluate
CLO-2	Separation of synthetic and natural samples by chromatographic methods	PSO-5	Apply, Analyse and Evaluate
CLO-3	Separation of samples-based on charge, molecular mass, lock-key mechanism	PSO-5	Apply, Analyse and Evaluate
CLO-4	Solvent extraction methods- extraction systems such as acid, metal complexes, solid phase extraction systems	PSO-5	Remember, Understand, Apply and Analyse
CLO-5	Electrophoretic methods-separation based on electrophoresis and electro-osmotic flow	PSO-5	Understand, Apply, Analyse and evaluate
CLO-6	Problems related to the chromatographic separation	PSO-5	Evaluate

COURSE CONTENTS:

Module-1		**16 hrs**
1.1	**Chromatography:** Definition, principles and mechanism of separation, classification of chromatographic techniques. General descriptions of column chromatography - frontal analysis, displacement analysis and elution analysis. General theory of column chromatography: characterizing a chromatogram - retention time, retention volume and baseline width. Chromatographic resolution, capacity factor, column selectivity. Column efficiency – band broadening - rate theory and plate theory. Peak capacity, non ideal behavior. Optimizing chromatographic separations using capacity factor, column selectivity and column	**10hrs**

	efficiency - Van Deemter equation, and its modern versions, Golay equation and Huber-Knox equation.	
1.2	**Gas chromatography (GC):** Principles, instrumentation mobile phase, chromatographic columns, stationary phases, sample introduction, temperature control, and detectors for gas chromatography. Quantitative and qualitative.	**2 hrs**
1.3	**High performance liquid chromatography (HPLC):** Principles, instrumentation – columns (analytical and guard columns), stationary phases, mobile phases, choosing a mobile phase, isocratic *vs* gradient elution, HPLC plumbing, sample introduction. Detectors for HPLC - spectroscopic, electrochemical and others, quantitative applications.	**4 hrs**
Keywords: Chromatography-Introduction, Mathematical equations, Gas chromatography, High performance liquid chromatography		

Module - 2		**16hrs**
2.1	**Ion exchange chromatography (IEC):** Definitions, requirements for ion-exchange resin, synthesis and types of ion-exchange resins, principle, basic features of ion- exchange reactions, resin-properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes. IEC with eluent suppressor columns. Single column ion chromatography.	**5hrs**
2.2	**Size-exclusion chromatography:** Theory and principle of size-exclusion chromatography, experimental techniques of gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing - factors governing column efficiency, methodology and applications.	**3hrs**
2.3	**Thin layer chromatography:** Principle, apparatus and methodology, applications, HPTLC.	**1hrs**
2.4	**Affinity chromatography:** Definitions, separation-mechanism-matrices, matrix activation, role of spacer arms and applications.	**1hrs**
2.5	**Supercritical fluid chromatography (SFC):** Properties of supercritical fluids, instrumentation and operating variables, comparison of SFC with other types of chromatography, applications.	**3hrs**
2.6	**Supercritical fluid extraction:** Advantages of supercritical fluid extraction, instrumentation, supercritical fluid choice, off-line and on-line extractions, typical applications of supercritical fluid extraction.	**3hrs**
	Key word: IEC, SEC, TLC, AC, SFC, SCF	

Module-3		**16hrs**
3.1	**Electrophoretic methods** - Electrophoresis & Capillary	**8hrs**

	Electrophoresis**:** Theory - electrophoretic mobility, electroosmotic mobility, electroosmotic flow velocity, total mobility, migration time, efficiency, selectivity and resolution. Instrumentation - capillary tubes, hydrodynamic and electrokinetic methods of sample injection, applying electric field and detectors. Capillary electrophoresis methods - capillary zone electrophoresis, micellar electrokinetic capillary chromatography, capillary gel electrophoresis and capillary electro chromatography.	
3.2	**Solvent extraction:** Theory - Nernst partition law, efficiency and selectivity of extraction.	**1hr**
3.3	**Extraction systems:** Extraction of covalent neutral molecules, extraction of uncharged metal chelates and synergic extraction, extraction of ion-association complexes - non chelated complexes, chelated complexes and oxonium systems. Use of salting out agents. Methods of extraction - batch and continuous extractions. applications.	**4hrs**
3.4	**Solid Phase Extraction (SPE):** Principles, apparatus and instrumentation. Solid phase sorbents, extraction formats - Automated solid phase extraction. Solid phase micro extraction (SPME). Applications of SPE and SPME.	**3hrs**
	Key words: Solvent extraction, electrophoresis, solid phase extraction systems	

80% Theory and 20% Problems

References:

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Analytical chemistry	G. D. Christian	Wiley publication	6th	2013
2	Fundamentals of Analytical Chemistry	Skoog, West, Holler, Crouch	Saunders College Publishing, New York,	8th	2004
3	Modern chemistry Analytical	David Harvey	Mcgraw Hill	1st	2000
4	Analytical 2.0 Chemistry	David Harvey	McGraw-Hill Companies, Depauw	1st	2018
6	Instrumental methods of chemical analysis	G. R. Chatwal, S. K. Anand	Himalaya publishing House,	5th	2002.
7	Fundamental of Analytical Chemistry	D.A. Skoog, D.M. West, Holler and Crouch	Saunders College Publishing, New York,	8th	2005
8	Instant Notes of Analytical Chemistry	Kealey and Haines,	Viva Books Pvt. Ltd.,		2002.

9	Principles and Practice of Analytical Chemistry	by F. W. Fifield and Kealey,	Blackwell Sci., Ltd. Malden, USA,	5^{th}	2000
10	Principles of instrumental analysis	Holler, crouch and Skoog	Cengage Learning	6^{th}	2007

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Course Title	**INORGANIC CHEMISTRY-II**								
Course Type	**Hard Core- Theory**		**Total Hours**	**48**	**Hours/Week**		**04**	**Credits**	**02**
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand the structural arrangements of the ligands around the metal atom and constitution of and geometry of higher coordination number.
CO-2	Thermodynamics and stability of complex formation
CO-3	Understand the electronic structures and the concept of magnetism
CO-4	Elucidate the electronic spectras
CO-5	Understanding of organometallic chemistry in Catalysis, Synthesis of Natural Product and Drug Discovery.
CO-6	Knowledge of important catalytic reactions and their applications to organic chemistry including alkene metathesis, catalytic coupling reactions, stereo selective reduction etc.

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Ligand field splitting parameter, Calculation of the LFSE	PSO-1	Understand, Apply and Analyse
CLO-2	Kinetic consequences of Reaction pathways	PSO-1	Understand, Analyse
CLO-3	Inferring the electron configuration from a magnetic moment.	PSO-1	Apply, Analyse and Evaluate
CLO-4	Understand the pi bonding and the selection rule and calculation of magnetic properties.	PSO-1, PSO-5	Understand, Apply, Analyse, Evaluate
CLO-5	Calculation of term symbols of d systems, electronic spectra, Racah paramenters	PSO-1, PSO-5	Analyse, Apply, Evaluate
CO-6	Interpret the influence of chemical behaviours on catalytic cycle.	PSO-1	Understand, Remember
CO-7	Ziegler-Natta, a heterogeneous polymerization of catalysis.	PSO-1	Remember, Analyse, Apply.

Module – 1	**16hrs**

1.1	**Preparation of coordination compounds**: Introduction, Preparative methods- simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions. Geometries of metal complexes of higher coordination numbers (2-8).	**3hrs**
1.2	**Stability of coordination compounds:** Introduction- thermodynamic and kinetic stability; stability constants (formation constants) -stepwise (K_n) and overall stability (β_n)constants, Trends in stepwise stability constants, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligands, chelate effect, macrocyclic effect, the Irving-William series.	**4hrs**
1.3	**Crystal field theory:** Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, measurement of 10 Dq and factors affecting it CFSE, high spin-low spin cross over – limitations-Jahn - Teller effect (static,dynamic, elongation and flattening) **Ligand Field theory** - Evidences for M-L overlap, Nephelauxetic effect.	**6hrs**
1.4	**Molecular Orbital Theory:** MOT to octahedral, tetrahedral, tetragonal and square planar complexes with and without pi-bonding. **Key words:** Stability of coordination compounds, CFT, CFSE	**3hrs**
Module – 2		**16 hrs**
2.1	**Electronic spectra**: Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for dn ions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra.	**3hrs**
2.2	**Magnetic properities**: Introduction, magnetic susceptibility and its measurements, spin and orbital contributions to the magnetic moment, the effects of temperature on μeff, spin-cross over, ferromagnetism, antiferromagnetism and ferrimagnetism.	**3hrs**
2.3	**Homogeneous catalysis - Industrial Applications:** Alkene hydrogenation, hydroformylation, The Wacker's process, Monsanto acetic acid process and L-DOPA synthesis, alkene oligomerizations, water-gas shift reactions.	**3hrs**
2.4	**Heterogeneous catalysis - Commercial Applications:** Alkene polymerization: Ziegler-Natta catalysis, Fischer-Tropsch carbon chain growth.	**3hrs**
2.5	**Biological and Medicinal Applications:** Organomercury, boron, silicon and arsenic Compounds	**2hrs**
2.6	**Alkene metathesis**, hydroboration, arylation or vinylation of olefins (Heck reaction) ***Keywords: Electronic spectra, magnetic properties, Homogenous, heterogeneous catalysis, Industrial applications.***	**2hrs**
Module - 3		**16hrs**
3.1	**Reactions and Mechanisms:** Introduction. Substitution reactions- Inert and labile compounds, mechanisms of substitution. Kinetic consequences of Reaction pathways Dissociation, interchange and association. Experimental evidence in octahedral substitution- Dissociation, associative mechanisms, the conjugate base mechanism, the kinetic chelate effect.	**4hrs**
3.2	**Stereochemistry of reactions-** Substitution in trans and its complexes, isomerization of chelate rings. Substitution reactions of square-planar complexes-kinetics and stereochemistry of square-planar substitutions, evidence for associative reactions, explanations of the trans effect.	**4hrs**
3.3	**Electron-transfer processes**: Inner-sphere mechanism and outer-sphere mechanism, conditions for high and low oxidation numbers.	**4hrs**

3.4	**Applications of infrared spectroscopy of coordination compounds**: Metal complexes of ammine, nitro, nitrito, hydroxo, carbonato, sulphato, cyano, cyanato and thiocyanato complexes. ***Key words: Stereochemistry, Electron-transfer processes***	**4hrs**

References:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Physical Inorganic Chemistry- A Coordination Chemistry Approach	S.F.A. Kettle	Spektrum, Oxford		1996
2	Concise Coordination Chemistry	R. Gopalan and V. Ramalingam.	--	--	--
3	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter.	Pearson Education	4th	2013
4	Basic Concepts of	D.N. Singh	Pearson Education,	2nd	2010
5	Inorganic chemistry	Mark Weller, TinaOverton	Oxford Uiversity press	6th	2010
6	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
7	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004
8	Concise Inorganic Chemistry	J.D. Lee	Blackwell Science Ltd.,	5th	2003
9	Inorganic Chemistry	Catherine E. *Housecroft* And G. Sharpe Alan	Pearson Education	2nd	2003
10	Basic Organometallic Chemistry	B.D. Gupta and A.J. Elias	Universities Press	1st	2010
11	Concise Coordination Chemistry	R.Gopalan and V.Ramalingam.	--	--	--

Suggested readings

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Physical Inorganic Chemistry- A Coordination Chemistry Approach	S.F.A. Kettle	Spektrum, Oxford	--	1996
2	Concise Coordination Chemistry	R.Gopalan and V.Ramalingam.	--	--	--
3	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
4	Inorganic chemistry	Mark Weller, Tina Overton	Oxford Uiversity press	6th	2010
5	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
6	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004
7	Advanced Inorganic Chemistry	F. A. Cotton and G. Wilkinson	Wiley-Eastern Company	6th	1990
8	Basic Organometallic Chemistry: Concepts, Syntheses, and Applications of Transition Metals	Gupta, B. D., and Elias, Anil. J	Universities Press, CRC Press	1st	2010.

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Course Title	**REAGENTS IN ORGANIC CHEMISTRY AND MOLECULAR REARRANGEMENTS**								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits		03
Course Code	B0230	Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	**Course Objectives**
CO-1	To understand the concept of rearrangements in organic reactions
CO-2	To know the concepts of reaction mechanism and its applications
CO-3	To Identify suitable reagent for various Organic Reactions
CO-4	To understand the concepts of protection- deprotection and its applications
CO-5	To introduce range of key reactions for application in organic syntheses.
CO-6	Develop basic skills for the multi-step synthesis of organic compounds

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Knowledge of key reactions in organic chemistry including reactions involving enols and enolates.	**PSO-5**	Understand
CLO -2	Rationalisation of the outcome of organic reactions using mechanistic reasoning	**PSO-5**	Understand and Apply
CLO -3	Ability to apply protection –deprotection strategies to plan organic syntheses	**PSO-5**	Understand and apply
CLO -4	Understanding of Reagents in synthesis	**PSO-5**	Apply
CLO -5	Knowledge of the retrosynthetic approach to planning organic syntheses.	**PSO-5**	Apply
CLO -6	Plan synthesis of desired product.	**PSO-5**	Analyze and Create

COURSE CONTENTS

Module 1		**16hrs**
1.1	**Molecular rearrangements:** Introduction **Carbon to Carbon migration**: Pinacol-pinacolone, Wagner-Meerwein, Benzidine, Demjanov, benzylic acid, Favorskii, Arndt-Eistert synthesis, Fries rearrangement, Steven's rearrangement, dienophine rearrangement	**6hrs**
1.2	**Carbon to Nitrogen migration**: Hofmann, Curtius, Lossen, Schmidt and Beckmann rearrangement.	**4hrs**
1.3	**Miscellaneous rearrangements**: Sommelet-Hauser, Neber, Japp-Klingemann rearrangement, Meisenheimer rearrangements, Bayer-Villeger rearrangement, Allylic rearrangements ***Key words- Carbocation, carbanion, Imines.***	**6hrs**
Module 2		**16 hrs**
2.1	**Reagents in organic synthesis:** Use of following reagents in organic synthesis and functional group transformations: Lithium disopropylamide (LDA), Gilman reagent, dicyclohexyl carbodimide (DCC), dichloro dicyano quinone (DDQ), trialkyl silyl halides, trimethyl silyl cyanide, phase transfer catalyst, crown ethers, cyclodextrins, Fenton's reagent, Ziegler-Natta catalyst, diazomethane, tributyl tinhydride, stannous chloride, Sharpless epoxidation, Woodward and Prevost hydroxylation, Stork enamine reaction. Microwave induced organic synthesis, ionic liquids in organic synthesis, polymer supported reagents and synthesis, the use of ultra sound in organic synthesis. ***Key words- Oxidation, Dihydroxylation, Reduction, Hydrogenation***	**16hrs**
Module 3		**16 hrs**
3.1	**Protecting groups:** Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis.	**3hrs**

3.2	**Name reactions:** Keto-enol tautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Schmidt reaction, Perkin reaction, Knoevenagel, benzoin and Stobbe condensation, Darzens glysidic ester condensation, Cannizaros reaction, Tischenko reaction. Michael addition, Robinson's annulation reaction.	**6hrs**
3.3	**Retrosynthesis:** Introduction to disconnection approach: Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Synthons and synthetic equivalents. Retrosynthesis and synthesis of benzofurans, *p*-methoxy acetophenone, saccharine, α-bisabolene, nuciferal, penicillin-V. ***Key words- Protection-Deprotection, Retroanalysis, Enolate ion.***	**7hrs**

70% Problems (in the form of Predicting products) and 30% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Organic Chemistry	Robert. N. Boyd and Robert Thornton Morrison	Pearson	6th	2016
2.	A Guide Book to Mechanism in Organic Chemistry	Petersykes	Pearson	6th	2003
3.	Advanced Organic Chemistry	J. March	Wiley	7th	2013
4.	Organic Reaction Mechanism.	R.K. Bansal,	Wiley Eastern Limited, New Delhi,		1993
5.	Organic Chemistry	Marye Anne Fox, James K. Whitesell	Jones & Bartlett Learning	3rd illustrated	2004
6.	Mechanism and Structure in Organic Chemistry	E.S. Gould H. Pine, Hendrickson, Cram and Hammond	Mac Grow Hill, New York		1987
7.	Reactions, Rearrangements and Reagents	Somorendra Nath Sanyal	Bharati Bhavan	4th	2019
RECOMMENDED BOOKS					
8.	Principles of Organic Synthesis,	ROC Norman and J. M. Coxon	CRC Press	6th	1996
9.	Advanced Organic Chemistry	F. A. Carey and R. J. Sundberg,	Plenum		1990
10.	Basic Principles of Heterocyclic Chemistry	Malcolm Sainsbury	RSC	-	2001

Course Title	**PRINCIPLES OF PHYSICAL CHEMISTRY**								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits		03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand the level of mathematics as a tool to understand atomic and molecular structure and properties as well as chemical reactivity.
CO-2	To acquire hands on experience with a quantum mechanics software package.
CO-3	Synthesis and Characterisation of polymers.
CO-4	Technological developments in commodity and advanced polymers.
CO-5	To link thermodynamics to the micro description used in statistical mechanics.

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Evaluating the different parameters like entropy enthalpy and free energies.	PSO-1	Evaluate and Apply
CLO-2	Kinetics, mechanism of free radical polymerization and methodology used of control molecular weight of polymers.	PSO-1	Understand and apply
CLO-3	Different techniques of polymerization of polymers.	PSO-1	Apply, and Analyse
CLO-4	Conceptual understanding of quantum mechanics of atoms and molecules.	PSO-1	Understand
CLO-5	Applying the concept and solving the problems on different aspects.	PSO-1	Understand and Apply
CLO-6	Defines the importance of phase diagram in the field of material science and engineering	PSO-1	Analyse and apply

COURSE CONTENTS

Module-1		**16 hrs**
1.1	Wave-particle duality of material particles, deBroglie equation, Heisenberg Uncertainty principle, Concept of operators (operator–operand), Algebra of operators, commutative and non commutative operators, linear operator, Laplacian operator, Hamiltonian operator, Eigen value, Eigen function, class Q function, Hermitian operator, Wave equation for stretched strings, Schrodinger wave equation for particles, Eigen values and Eigen functions, Postulates of quantum mechanics. Application of Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions). Wave equation for H-atom,	**16hrs**

	Application of Schrodinger equation to rigid rotator and harmonic oscillator. Approximate methods – Necessity of approximate methods, perturbation method, the theory of perturbation method – first order and second order correction, Variation theorem: statement and proof. ***Key words- Functions, Particle, one, two dimensions.***	
Module-2		**16 hrs**
2.1	**Statistical mechanics**: Introduction, types of ensembles, thermodynamic probability, relation between entropy and thermodynamic probability. Partition function – Evaluation of translational, rotational, vibrational and electronic partition functions for mono atomic, diatomic and polyatomic gaseous molecules. Suckur-tetrode equation for entropy of translational function. Calculations of thermodynamic functions and equilibrium constants in terms of partition functions. Different distribution laws (Types of statistics) Boltzmann, Bose–Einstein, Fermi-dirac statistics- and their comparison –problems and their solutions.	**10hrs**
2.2	**Phase rule studies:** Thermodynamic derivation of phase rule. Application of phase rule to the two component systems – compound formation with congruent melting point and incongruent melting points, Roozeboom's classification. Application of phase rule to three component systems. Systems of three liquids and systems of two ***Key words- Probability, entropy, Partition functions, Statistics.***	**6hrs**
Module – 3		**16 hrs**
3.1	**Polymers**: Fundamentals of polymers - monomers, repeat Units, degree of Polymerization. Linear, branched and network polymers. Classification of polymers. Kinetics of Polymerization - Condensation, addition, free radical, ionic, co-ordination polymerization and ring opening polymerization. Molecular weight and size. Polydispersion. Average molecular weight concepts – number, weight and viscosity average molecular weight. Determination of molecular weights - viscosity method, osmotic pressure method, sedimentation and light scattering method. **Phase transitions in polymers and thermal characterization**: Glass transition crystallinity and melting – correlation with the polymer structure. **Polymers in solution**: Criteria of polymer stability, thermodynamics of polymer solutions.	**16hrs**

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Physical Chemistry	P.W. Atkins	ELBS, Oxford University Press	4^{th}	1990
2	Quantum Chemistry	R.K. Prasad	New Age International Publishers		1996
3	Elementary Statistical Thermodynamics by	N.D. Smith	Plenum Press, NY	----	1982
RECOMMENDED BOOKS					
1	Physical Chemistry	P.W. Atkins	ELBS, edition, Oxford	fourth	1990

2	Group Theory and its Chemical Applications	P.K. Bhattacharya	Himalaya Publishing House	---	1986

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THIRD SEMESTER

Course Title	INSTRUMENTAL METHODS OF ANALYSIS							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code	C0210	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Qualitative and quantitative analysis based on flame excitation methods such as FES and AAS
CO-2	Molecular luminescence techniques for scattering systems
CO-3	Electrochemical methods based on electron sensitive sensors
CO-4	Applications such as amperometry, coulometry, voltammetry, electrogravimetry
CO-5	Thermal method study such as TGA, DTA, DSC and enthalpimetry

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Atomic absorption methods- AAS, FES introduction and application	PSO-5	Remember, Understand, Apply and Analyse
CLO-2	Luminiscence- Fluoroscence and phosphorescence- theory and application	PSO-5	Remember, Apply, and Analyse
CLO-3	Electrochemical methods- theory and development of sensors	PSO-5	Remember, Apply, Analyse and evaluate
CLO-4	Coulometry and voltammetry-diffusion methods-applicability	PSO-5	Remember, Understand, Apply, and Analyse
CLO-5	Thermal methods- TGA, DTA-problematic approach	PSO-5	Remember, Analyse and apply
CLO-6	Thermal methods- DSC and enthalpimetric analysis-problems with solutions	PSO-5	Remember, apply and analyse

COURSE CONTENTS:

Module -1	**16 hrs**

1.1	**Flame photometry and Atomic absorption spectrometry:** Energy level diagrams – atomic absorption spectra. Flame characteristics. Flame atomizers and electrothermal atomization. Comparison of spectral interferences, chemical and physical interferences in FP and AAS. Use of organic solvents. Quantitative techniques - calibration curve procedure and the standard addition technique. Typical commercial instruments for FP and AAS, applications. Qualitative analysis and quantitative evaluations. Relative detectabilities of atomic absorption and flame emission spectrometry.	**8hrs**
1.2	**Molecular luminescence spectrometry:** Theoretical basis for fluorescence and phosphorescence. Singlet and triplet excited states. Variables affecting luminescence – quantum efficiency, transition types, structure and structural rigidity, temperature and solvent effects, effect of *p*H, dissolved oxygen and concentration effect. Excitation spectra *vs* emission spectra. Fluorescence instrumentation - fluorometers and spectrofluorometers. Sensitivity and selectivity. Modification necessary to measure phosphorescence. General scope of applications of luminescence.	**6hrs**
1.3	**Nephelometry and turbidometry:** Principles, instrumentation and applications.	**2hrs**
	Key words: Flame and atomic absorption, luminescence, Nephelometry and turbidometry	

Module-2		**16 hrs**
2.1	**Classification of electrochemical methods:** Controlling and measuring current and potential potentiometers, galvanostats and potentiostats. Potentiometric methods of analysis. Potentiometric electrochemical cells. The Nernst equation. Liquid junction potentials. Reference electrodes - SHE, calomel electrode and silver/silver chloride electrode. Metallic indicator electrodes - electrodes of first kind and second kind. Redox electrodes. Membrane electrodes – membrane potential, selectivity of membranes. Glass ion selective electrodes. Crystalline solid state ion selective electrodes. Liquid-based ion selective electrodes. Gas sensing electrodes. Potentiometric biosensors. Quantitative applications. Activity *vs* concentration. Quantitative analysis using external standards and the method of standard additions. Measurement of *p*H. Clinical and environmental applications.	**6hrs**
2.2	**Electrogravimetric analysis:** Theory, apparatus, cell processes, deposition and separation, electrolytic separation of metals, applications.	**2hrs**
2.3	**Coulometric methods of analysis:** General discussion, coulometry at controlled potential, apparatus and general technique, applications, coulometric titrations (amperometric coulometric) - principles, apparatus, comparison of coulometric titrations with conventional titrations, automatic coulometric titrations, applications.	**4hrs**

2.4	**Voltammetry:** Fundamentals of voltammetry. Cyclic voltammetry**:** Principles and applications. Stripping analysis: Stripping voltammetry - basic principles, electrodes used for stripping analysis, apparatus for stripping analysis, applications, determination of lead in water voltammetry with micro electrodes.	**4hrs**
	Keywords: Electrodic sensors, Electrogravimetric methods, coulometry, voltammetry, diffusion methods	

Module-3		**16 hrs**
3.1	**Thermal method of analysis:** Introduction	**1 hr**
3.2	**Thermogravimetric analysis (TGA):** types of thermogravimetric analysis, principles. Factors affecting the results - heating rate, furnace, instrument control/data handling. Applications - purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination of kinetic parameters of thermal degradation.	**4hrs**
3.3	**Differential thermal analysis (DTA):** Theory - variables affecting the DTA curves. Differences between TGA and DTA. General principles. Instrumentation. Applications - analysis of the physical mixtures and thermal behaviour study. Determination of melting point, boiling point and decomposition point.	**3hrs**
3.4	**Differential scanning calorimetry (DSC):** Basic principle. Differences between DTA and DSC. Instrumentation - power compensated DSC, Heat flux DSC. Applications - studies of thermal transitions and isothermal crystallization. Pharmaceutical industry for testing the purity of the samples. Thermomechanical analysis. Dynamic mechanical analysis.	**5hrs**
3.5	**Enthalpimetric analysis:** Thermometric titrimetry and direct injection enthalpimetry – principle, instrumentation, applications.	**3hrs**
	Key words: Thermal methods-TGA, DTA, DSC, enthalpimetric analysis	

60% Theory and 40% Problems

References:

Sl.No	Title of the book	Name of the author	Name the publisher	Edition	Year of publication
1	Analytical chemistry	G. D. Christian	Wiley publication	6th	2013
2	Fundamentals of Analytical Chemistry	Skoog, West, Holler, Crouch	Saunders College Publishing, New York,	8th	2004
3	Modern Analytical chemistry	David Harvey	Mcgraw Hill	1st	2000
4	Analytical Chemistry 2.0	David Harvey	McGraw-Hill	1st	2018

5	Instrumental methods of chemical analysis	G. R. Chatwal, S. K. Anand	Himalaya publishing House, Companies , Depauw	5th	2002.
6	Fundamental of Analytical Chemistry	D.A. Skoog, D.M. West, Holler and Crouch	Saunders College Publishing, New York,	8th	2005
7	Principles of instrumental analysis	Holler, crouch and Skoog	Cengage Learning	6th	2007
8	Spectroscopy	H. Kaur`	Pragathi prakashan	11th	2016
9	Instrumental Methods of Analysis	Supriya S. Mahajan	Popular Prakashan Private Ltd	1st	2010
10	Analytical Chemistry	S. M. Khopkar	New age international publishers	1st	2013

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Course Title	**MOLECULAR SYMMETRY AND SPECTROSCOPY**							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 arks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Symmetry elements and symmetry operations,
CO-2	Matrix representation of symmetry operations and applications
CO-3	Microwave rotational and vibrational (IR and Raman) spectroscopy
CO-4	Electronic transitions-UV Vis spectroscopy and application in structure elucidation
CO-5	Basics of ESR and its application to free radical system

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Molecular symmetry and group theory	PSO-1	Understand, Apply
CLO-2	Application of group theory to vibrational spectroscopy	PSO-1	Apply, Analyse and Evaluate
CLO-3	Introduction to microwave spectroscopy	PSO-1	Understand
CLO-4	Vibrational spectroscopy towards structural elucidation	PSO-1	Understand, Apply and Analyse
CLO-5	UV-Vis spectroscopy introduction and contribution for structure elucidation	PSO-1	Understand, Apply and Analyse
CLO-6	ESR: Basics and application	PSO-1	Understand

COURSE CONTENTS:

Module -1		**16 hrs**
1.1	**Molecular Symmetry And Group Theory:** Introduction, symmetry elements and symmetry operations, Definitions, theorems, classes and similarity transformations, Classification of point group based on the flow chart, Subgroups, Multiplication tables (C_n, C_{2V} and C_{3V}). Isomorphism, Matrix representation of symmetry operations (Rotations, reflections-plane, inversion, identity, rotation-reflection, reflection plane inclined at certain arbitrary angle-derivation required). Reducible and irreducible representation, Notations for irreducible representation: The Great Orthogonality theorem and its consequences. Construction of character table Character tables (C_s, C_i, C_{2v} , C_{3v}, C_{2h}, C_2 and C_3).	**10 hrs**
1.2	**Application of group theory to symmetry:** Direct product representation, Chemical application of group theory: molecular vibrations (non-linear molecules belonging to C_{2v}, C_{2h} and C_{3v}). Bonding with the central atom and formation of hybrid atomic orbitals taking methane and boron tri fluoride as examples. Group theoretical selection rules: Electronic transitions (Carbonyl chromophore by taking formaldehyde as example), IR spectra, Raman spectra.	**6 hrs**
	Keywords: Group theory, point groups, Great orthogonality theorem, IR and Raman activity	

Module - 2		**16 hrs**
2.1	**Microwave spectroscopy:** Rotation spectra of diatomic Molecules - rigid and non rigid rotator model. Rotational quantum number and the selection rule. Effect of isotopic substitution on rotation spectra. Relative intensities of the spectral lines. Classification of polyatomic molecules based on moment of inertia - Linear, symmetric top, asymmetric top and spherical molecules. Rotation spectra of polyatomic molecules (OCS CH_3F and BCl_3). Moment of inertia expression for linear tri-atomic molecules. Experimental techniques - Microwave spectrometer. Stark effect in rotation spectra and determination of dipole moments.	**8 hrs**
2.2	**Vibration spectroscopy*:*** Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator. Effects of anharmonic oscillation. Vibration - rotation spectra of carbon monoxide. Combination, difference and hot bands, Fermi resonance, force constant and its significance. Theory of infrared absorption and theoretical group frequency. Intensity of absorption band and types of absorptions.Expressions for fundamental and overtone frequencies. Parallel and perpendicular vibrations (CO_2 and H_2O) **Applications:** Structure of small molecules XY_2-linear or bent, XY_3-Planar or pyramid.	**8 hrs**
2.3	**Raman spectroscopy:** Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Theories of Raman spectra - classical and quantum	**8 hrs**

	theory. Rotation-Raman and vibration-Raman spectra. Comparison of Raman and IR spectra, rule of mutual exclusion principle. Advantages of Raman spectra.	
	Keyword: Microwave, Vibrational (IR and Raman) spectroscopy	

Module -3		**16 hrs**
3.1	**UV Visible spectroscopy:** Introduction, electronic transitions, simple chromophoric groups - systems of extended conjugation - aromatic systems - types of auxochromes - Functions of auxochromes - absorption and intensity shift - types of transitions - transition probability - types of absorption bonds - solvent effects and choice of solvent - effect of polarity on various type of bonds Woodwards empirical rules for predicting the wavelength of maximum absorption for conjugated dienes, cyclic trienes and polyenes, α,β-unsaturated aldehydes and ketones	**10 hrs**
3.2	**ESR spectroscopy:** Principle, mathematical interpretation of spectroscopy, Instrumentation, Presentation of ESR spectrum, Spectrum of simple molecules such as Hydrogen atom, Methyl radical, Ethyl radical, CH_2OH radical, g-value, Some application of ESR studies in Free radical studies, organometallic chemistry	**06 hrs**
	Keyword: UV-Vis spectroscopy, ESR spectroscopy	

60% theory and 40 % application

REFERENCES:

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Group theory in Chemistry	MS Gopinathan, V. Ramakrishnan	Vishal publishing Co.,	2nd	2016
2	Inorganic Chemistry	Shriver and Atkins	International student edition	1st Indian Reprint Edition	2011
3	Inorganic Chemistry	Garr L Miessler and Donald A Tarr	Pearson Education international,	3rd	2005
4	Quantum Chemistry	Sannigrahi AB	Arunabha Sen Books and allied (p) ltd	2nd	2015
5	Organic Spectroscopy	W. Kemp	Pagrave Publishers, New York	3rd	1991

6	Spectrometric Identification of Organic Compounds	Silverstein, Bassler& Monnill	Wiley	-	2001
7	Spectroscopy of Organic Compounds	P.S.Kalsi	New Age, New Delhi	3rd	2000
8	NMR Spectroscopy in Inorganic Chemistry	J. A. Iggo	Oxford University Press	-	1999
9	Spectroscopy in Inorganic Chemistry	C. N. R .Rao and J. R. Ferraro	Academic Press	10th	2000
10	Spectroscopy	B. P. Straughan and S. Salker	John Wiley and Sons Inc., New York	9th	2006
11	Application of Absorption Spectroscopy of Organic Compounds	John R. Dyer	Prentice/Hall of India Private Limited, New Delhi	10th	2010

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Course Title	**ADVANCED PHYSICAL CHEMISTRY**								
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week		03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15				30 Marks	100
			External	Duration	03Hrs	C3		70 Marks	

COURSE OBJECTIVES

CO No.	Course Objectives
CO-1	Calculations of energy changes during nuclear reactions.
CO-2	Evaluation of photochemical rate laws for different photochemical reactions of organic molecules.
CO-3	Relating the concepts of energies with different electrochemical process
CO-4	Studing the kinetice of enzyme catalysed chemical reactions.
CO-5	Applications of radio isotopes in tracer technique.

MAPPING CLO'S WITH PSO'S AND CD'S:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Understand the importance of nuclear chemistry and its application	PSO-1	Evaluate and Apply
CLO-2	Calculations of energy changes during	PSO-1	Understand and apply

	nuclear reactions.		
CLO-3	Evaluation of photochemical rate laws for different photochemical reactions of organic molecules.	PSO-1	Apply, and Analyse
CLO-4	Deducing the kinetics of enzyme catalyzed reactions.	PSO-1	Understand
CLO-5	Applying the concept and solving the problems on different aspects.	PSO-1	Understand and Apply
CLO-6	Studing different electrochemical techniques	PSO-1	Analyse and apply

COURSE CONTENTS

Module-1		**16 hrs**
1.1	**Enzyme kinetics:** Effect of substrate concentration (Michaelis - Menton equation), Effect of pH, effect of catalysts and inhibitors (substrate, zeolite, Cr3+, Fe2+ ZnO, U.Vlight), effect of temperature. A brief kinetic and mechanistic applications of glucose oxidase in the oxidation of glucose.	**6 hrs**
1.2	**Linear Free Energy Relationship**: Hammett equation, Taft equation, Okemoto Brown equation and its application to oxidation of amino acids and aromatic amines. Swain-Scott and Edward equation. Winstein - Grunwald relationship. Isokinetic relationship and significance of isokinetic temperature, Exner criterion.	**7hrs**
1.3	**Kinetic Isotope Effect**: Theory of kinetic isotope effect - normal and inverse isotope effect, primary isotope effect, secondary isotope effect, solvent isotope effect. ***Key words- Enzyme, Kinetic effect, Isotopic effects, Catalysts, Inhibitors.***	**3hrs**
Module-2		**16 hrs**
2.1	**Nuclear chemistry**: Radioactive decay – General characteristics, decay kinetics, liquid drop model, and shell model, parent –daughter decay growth relationships, determination of half-lives, Nuclear stability – packing fraction, binding energy, Brief survey of alpha, beta and gamma decays. Nuclear reactions – Bethe's notation, types of nuclear reactions – specific nuclear reactions, photonuclear reactions, Oppenheimer – Phillips process for the separation of radio isotopes and spallation reactions. Definition of Curie and related calculations, Szilard-Chalmers process. Geiger-Muller counters – G.M. Plateau, dead time, coincidence loss, determination of dead time, Sintillation counters, Nuclar fission , fusion reactions, Nuclear power reactors- types, basic components and its applications.	**10 hrs**
2.2	**Radiation chemistry**: Introduction, Modules, interaction of electromagnetic radiation with matter, -value, LET of radiation, Fricke dosimeter. Radiolysis - cysteine and biphenyl. Radioisotopes as tracers, use of isotopic tracers in the elucidation of reaction mechanism, structure determination and solubility of sparingly soluble substances. ^{14}C dating, medical applications of isotopic tracers. Hazards in radiochemical work and radiation protection. ***Key words- Nuclear fission fusion, Half lives, Nuclear reactions, reactors. Isotopes, Tracers.***	**06 hrs**
Module – 3		**16 hrs**

3.1	**Photochemistry**: Introduction to photochemistry, quantum yield and its determination, factors affecting quantum yield, Actinometry - Uranyloxalate and potassium ferrioxalate actinometers, acetone and diethylketone actinometers. Term symbols and significance. Photosensitization: by mercury, dissociation of H2. Photochemical kinetics of: Decomposition of CH_3CHO, formation of HCl. Photodegradation: Photocatalyst – ZnO, TiO_2, principle, application of ZnO/TiO_2 in the photo degradation of dyes (IC), pesticides (DDT) and in industrial effluents. Effect of photo degradation on COD value. ***Key words**: **Photocatalyst, Degradation, Actinometer, quantum yield.***	**16 hrs**

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Physical Chemistry	P.W. Atkins	ELBS, Oxford University Press	4^{th}	1990
2	Essentials of Nuclear Chemistry	H.J. Arnikar	Newage	4th	2004
3	Physical Chemistry	Arun Bhal and B.S. Bhal	S. Chand	13^{th}	1963
RECOMMENDED BOOKS					
1	Physical Chemistry	P.W. Atkins	ELBS, edition, Oxford	fourth	1990
2	Chemical Kinetics	K.J. Laidler	Pearson	Third	2003

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Course Title	**ANALYTICAL CHEMISTRY PRACTICALS-II**								
Course Type	Soft Core- Practical		Total Hours	96	Hours/Week	04	Credits		**02**
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Quantitative analysis of water samples by EDTA titrations
CO-2	Quantitative analysis based on Flame emission methods
CO-3	Potentiometric and conductometric determination
CO-4	Analysis of waste water for DO and COD
CO-5	Spectrophotometric methods of analysis

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Quantitative analysis using precipitation titration	PSO-3	Apply Analyse and Evaluate
CLO-2	Quantitative analysis using spectrophotometric method	PSO-3	Apply, Analyse and Evaluate
CLO-3	Quantitative analysis by complexometric titration	PSO-3	Apply, Analyse and Evaluate
CLO-4	Quantitative analysis by acid base titration	PSO-3	Apply Analyse and Evaluate
CLO-5	Quantitative analysis by flame photometric method	PSO-3	Apply Analyse and Evaluate
CLO-6	Quantitative analysis using potentiometry and conductometry	PSO-3	Apply Analyse and Evaluate

COURSE CONTENTS:

Part III	
	1. Determination of calcium in limestone by redox, acid-base and complexation titrations. 2. Determination of mercury in an algaecide by EDTA titration; and arsenic in ant control preparation by redox titration. 3. Determination of aluminium and magnesium in antacids by EDTA titration. 4. Determination of zinc in a sample of foot powder and thallium in a sample of rodenticide by EDTA titration. 5. Determination of saccharin in tablets by precipitation titration. 6. Determination of iodine value and saponification value of edible oils. 7. Analysis of a mixture of iron(II) and iron(III) by EDTA titration using *p*H control. 8. Potentiometric titration of a mixture of chloride and iodide. 9. Determination of sulpha drugs by potentiometry using $NaNO_2$ and iodometric assay of penicillin. 10. Polarographic determination of copper and zinc in brass. 11. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry. 12. Determination of manganese in steel by extraction-free spectrophotometry and molybdenum in steel by extractive spectrophotometry
Part IV	
	1. Analysis of waste waters for DO and COD by titrimetry. 2. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry. 3. Determination of chromium(III) and iron(III) in a mixture by kinetic masking methods. 4. Photometric and potentiometric titration of copper with EDTA. 5. Analysis of brackish water for chloride content by a**)** spectrophotometry (mercuric thiocyanate method), b) conductometry (silver nitrate) and c**)**

	potentiometry (silver nitrate). 6. Conductometric titration of sodium acetate with HCl and NH_4Cl with NaOH. 6. Spectrophotometric determination of iron in natural waters using thiocyanate and 1,10- phenanthroline as reagents. 7. Determination of fluoride in drinking water/ground water by spectrophotometry (alizarin red lake method). 8. Analysis of waste water for a) phosphate by molybdenum blue method b) ammoni-nitrogen by Nessler's method c) nitrite-nitrogen by NEDA method 9. Analysis of a soil sample for a) Calcium carbonate and organic carbon by titrimetry b) calcium and magnesium by EDTA titration 10. Analysis of a soil sample for a) Available phosphorus by spectrophotometry b) Nitrate-nitrogen/nitrite nitrogen/ammonia nitrogen by spectrophotometry c) sodium and potassium by flame photometry. 11. Analysis of urine for a) urea and uric acid by titrimetry snd spectrophotometry b) Sulphate by precipitation titration after ion-exchange separation c) sugar by Benedict' s reagent

100% practical

References

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Analytical chemistry	G. D. Christian	Wiley publication	6th	2013
2	Fundamentals of Analytical Chemistry	Skoog, West, Holler, Crouch	Saunders College Publishing, New York,	8th	2004
3	Modern Analytical chemistry	David Harvey	Mcgraw Hill	1st	2000
4	Analytical Chemistry 2.0	David Harvey	McGraw-Hill Companies, Depauw	1st	2018
5	Quantitative Analysis	R.A. Day and A.L. Underwood,	Prentice Hall, Inc. New Delhi,	6/E, 6th	2008
6	Vogel's Textbook of Quantitative Chemical Analysis	J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas	Pearson Education Pvt. Ltd., New Delhi	6th Third Indian Reprint	2003.
7	Instrumental methods of chemical analysis	G. R. Chatwal, S. K. Anand	malaya publishing House,	5th	2002.
8	Fundamental of Analytical Chemistry	D.A. Skoog, D.M. West, Holler and Crouch	Saunders College Publishing, New York,	8th	2005
9	Instant Notes of Analytical Chemistry by	Kealey and Haines,	va Books Pvt. Ltd.,		2002.
10	Principles and Practice	by F. W. Fifield	Blackwell Sci.,	5th	2000

	of Analytical Chemistry	and Kealey,	Ltd. Malden, USA,		
11	Principles of instrumental analysis	Holler, crouch and Skoog	Cengage Learning	6th	2007
12	Biochemical analysis	Irwin H Segel	Wiley	2nd	2004
13	Spectroscopy	H. Kaur`	Pragathi prakashan	11th	2016
14	Instrumental Methods of Analysis	Supriya S. Mahajan	Popular Prakashan Private Ltd	1st	2010
15	Analytical Chemistry	S. M. Khopkar	New age international publishers	1st	2013
16	Elements of Spectroscopy	Guptha, Kumar, Sharma	Pragati Edition	28th	2016
17	Calculations in Chemistry	John olusina obimakinde, Samuel Oluwaseun obimakinde	IK international publishing house	1st	2014

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Course Title	INORGANIC CHEMISTRY PRACTICALS-II							
Course Type	Soft Core- Practicals		Total Hours	96	Hours/Week	04	Credits	02
Course Code	DP320	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To introduce multistep inorganic compound synthesis and its spectroscopic analysis, separation and estimation of organic compounds.
CO-2	Composition of metal and ligand by spectrophotometric method.
CO-3	To acquire knowledge of laboratory techniques, inorganic synthesis and characterization.
CO-4	To impart the knowledge about redox, complexometric and precipitation reactions.
CO-5	Determination of stability constants of inorganic compounds.

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course learning outcome	PSOs Addressed	Cognitive Level
CLO-1	To acquire knowledge of laboratory techniques , inorganic synthesis and characterization.	PSO-3	Analyze,Apply Evaluate
CLO-2	Estimate the ions present in the sample by different techniques.	PSO-3	Analyze,Apply Evaluate
CLO-3	Flame photometric determination.	PSO-3	Analyze,Apply Evaluate
CLO-4	Determination of stability constants of inorganic compounds.	PSO-3	Analyze,Apply Evaluate
CLO-5	To impart the knowledge about redox, complexometric and precipitation reactions.	PSO-3	Analyze,Apply Evaluate

PART – III

1. Determination of bismuth, cadmium and lead in a mixture: Analysis of a low melting alloy (Wood's alloy).
2. Simultaneous spectrophotometric determination of chromium and manganese in a steel solution.
3. Quantitative analysis of copper(II) and iron(II) in a mixture:
   i. Copper gravimetrically as CuSCN and
   ii. Iron volumetrically using cerium(IV) solution
4. Determination of chromium(III) and iron(III) in a mixture: Kinetic masking method.
5. Electrogravimetric determination of:
   a) Copper in copper sulphate
   b) Nickel in nickel suphate
   c) Copper and nickel in alloy solution
   d) Lead in lead nitrate.
6. Flame photometric determination of the following metal ions from different samples:
   a) sodium b) potassium c) calcium d) lithium and d) sodium and potassium in a mixture.
7. Polarographic estimation of cadmium and zinc.
8. Determination of iron as the 8-hydroxyquinolate by solvent extraction method.
9. Quantitative determination of nickel using dithizone and 1,10-phenanthroline by synergistic extraction.

10. Spectrophotometric determination of the *p*Ka value of methyl red.

PART – IV

1. Preparation and characterization of:
   a) Chloropentammine cobalt(III) chloride
   b) Estimation of chloride in a complex by potentiometric or ion-exchange method
   c) Record the electronic absorption spectrum of a complex and verify Tanabe Sugano diagram
2. Preparation of *cis*- and *trans*- dichlorobis(ethylenediammine) cobalt(III)chloride. Record the UV-Vis spectra and compare it with *cis*-form. Measure the molar conductance.
3. Preparation of hexamine cobalt(III) chloride and estimate cobalt ion.
4. Determination of magnetic susceptibility of any two compounds/complexes by Gouy method.
5. Determination of the composition of iron-phenanthroline complex by:
   (a) Job's method
   (b) mole-ratio method and
   (c) slope-ratio method.
6. Determine the stability constant of iron-tiron/iron-phenanthroline by Turner-Anderson method.
7. Preparation of tris(oxalate)ferrate(III) and estimate the metal ion.
8. Using chloropentamine cobalt(III) chloride, prepare nitro and nitritopentamine cobalt(III) chloride. Record the IR spectra of the isomers and interpret.
9. Estimate the chloride ion in a given complex by silver nitrate titration after ion- exchangeseparation.
10. Demonstration Experiments:
    (a) Recording and interpretation of IR and NMR spectra of complexes.
    (b) Spectrochemical series - Evaluation of Dq value.
    (c) DNA interaction with metal complexes by UV-visible absorption and viscosity methods.

100% practical

References

Sl.No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Quantitative Analysis	R.A. Day and A.L. Underwood,	Prentice Hall, Inc. New Delhi,	6th	2008
2	Vogel's Textbook of Quantitative Chemical Analysis	J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas	Pearson Education Pvt. Ltd., New Delhi	6th	2003.
3	Instrumental methods of chemical analysis	G. R. Chatwal, S. K. Anand	Himalaya publishing House,	5th	2002.
4	Fundamental of Analytical Chemistry	D.A. Skoog, D.M. West, Holler and Crouch	Saunders College Publishing, New York,	8th	2005
5	Principles of instrumental analysis	Holler, crouch and Skoog	Cengage Learning	6th	2007
6	Quantitative Chemical Analysis	Daniel C. Harris,		7th	2006
7	PracticalInorganic chemistry	Gurdeep Raj	GOEL Publishing house	26th	2015

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Course Title	**ORGANIC CHEMISTRY PRACTICALS-II**								
Course Type	Soft Core- Practicals		Total Hours	**96**	Hours/Week	04	Credits	02	
Course Code	DP330	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hr	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To understand the concept of extraction, isolation and Estimation techniques
CO-2	To understand th e concepts of reaction mechanism and its applications
CO-3	To Identify suitable reagent for various chemical conversion
CO-4	Develop basic skills for the multi-step synthesis of organic compounds
CO-5	To Practice various Chromatographic Techniques

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level

CLO-1	The ability to apply reagent knowledge Practically	**PSO-3**	Understand
CLO-2	Understanding the solution of problems related isolation and Purification	**PSO-3**	Apply and Analyse
CLO-3	Practical skills in handling Chromatographic Techniques	**PSO-3**	Apply
CLO-4	Evaluate the risks associated with an experiment	**PSO-3**	Analyse and

COURSE CONTENTS

PART – III		**48hrs**
1. 1	Oxidation of cyclohexanol to adipic acid via cyclohexanone	
1.2	Esterification: Preparation of benzoccaine from *p*-nitrotoluene	
1.3	Diazotization (Sandmeyer's reaction): Preparation of *p*-chlorobenzoic acid from *p*toluidine	
1.4	Molecular rearrangement: i. Preparation of *o*-hydroxy benzophenone from phenyl benzoate via Fries rearrangement ii. Prepartion of benzanilide from benzophenone oxime via Beckmann rearrangement.	
1.5	Preparation of luminol from phthalic anhydride	
1.6	Preparation of m-nitrobenzoic acid from methyl benzoate. ***Key words- Multistep Synthesis and Analysis***	
Part IV	**Isolation of natural products**	**48hrs**
2.1	Fractional crystallization: separation of mixture of naphthalene and biphenyl	
2.2	Fractional distillation: Separation of mixture of hexane and toluene.	
2.3	Thin layer chromatography: Separation of plant pigments	
2.4	Column chromatography: Separation of mixture of *o* and *p*-nitro anilines	
2.5	Isolation of piperine from pepper	
2.6	Isolation of caffeine from tea	
2.7	Isolation of azeleic acid from castor oil	
2.8	Estimation of sugars by Fehlings method	
2.10	Estimation of sugars by Bertrand's method	
2.10	Estimation of nitro groups ***Key words- Chromatographic Separation, Analysis and Estimation***	

60% Problems (in the form of Predicting products) and 40% Theory

REFERENCES

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1.	Comprehensive practical organic chemistry	V. K. Ahluwalia and Renu Agarwal	Universities Press	-	2001

2.	An Introduction to Practical Organic Chemistry	Caroline Frances Cornwallis	BiblioBazaar	-	2009
3.	Advanced Practical Organic Chemistry	By John Leonard, Barry Lygo, Garry Procter	Stanley Thrones Publishing	Second Edition	1994
4.	Manual of Organic Chemistry	Dey and Seetharaman	Allied Publishers,	-	1957
5.	Laboratory Manual of Organic Chemistry	R.K. Bansal	New Age International (P) Ltd. London	3rd edition	1996.
6.	A Text Book of Practical Organic Chemistry by Vol.III	A.I. Vogel,	Longman Scientific & Technical	-	1989
RECOMMENDED BOOKS					
1.	Practical Organic Chemistry	Mann & Saunders	Orient Longman	4th edition	2004
2.	Semi micro Qualitative Organic Analysis	Cheronis, Entrikin and Hodnet.	R.E. Krieger Publishing Company,	3, reprint	1983

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Course Title	**PHYSICAL CHEMISTRY PRACTICALS-II**								
Course Type	Soft core-Practicals		Total Hours	48	Hours/Week	04	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

COURSE OBJECTIVES:

CO No.	**Course Objectives**
CO-1	To demonstrate an ability to conduct experiments in the above sub-disciplines with mastery of appropriate techniques and proficiency using core chemical instrumentation and modeling methods
CO-2	To develop skills in quantitative modeling of static and dynamic chemical systems.
CO-3	To develop laboratory competence in relating chemical structure to spectroscopic phenomena
CO-4	To demonstrate the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions
CO-5	To demonstrate broad knowledge of descriptive Chemistry

MAPPING CLO'S WITH PSO'S AND CD'S:

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Think critically and analyze chemical problems.	PSO-3	Understand, Apply and Analyse
CLO-2	Present scientific and technical information resulting from laboratory experimentation in both written and oral formats	PSO-3	Apply and understand
CLO-3	Work effectively and safely in a laboratory environment.	PSO-3	Apply, Analyse and Evaluate
CLO-4	Use technologies/instrumentation to gather and analyze data.	PSO-3	Understand, Apply and evaluate
CLO-5	Work in teams as well as independently	PSO-3	Understand and Analyse
CLO-6	Apply modern methods of analysis to chemical systems in a laboratory setting	PSO-3	Analyse and understand

COURSE CONTENT:

1. Kinetics of reaction between sodium formate and iodine, determination of energy of activation.
2. To study the kinetics of saponification of ethyl acetate by conductivity method, determination of the energy of activation.
3. Determination of mean ionic activity coefficient of a weak electrolyte (acetic acid) by conduct metric measurements.
4. To study the acid catalyzed kinetics of oxidation of glycine by chloramine-T (CAT) - determination of order of reaction with respect to [CAT] and [glycine].
5. To determine the eutectic point of a two component system (Naphthalene-*m*-dinitrobenzene)
6. Conduct metric method of determination of solubility of sparingly soluble salt.
7. Potentiometric titration of mixture of KCl + KBr + KI against$AgNO_3$.
8. Study of phase diagram of a three component system (acetic acid-chloroform and water)
9. Kinetics of decomposition of diacetone alcohol by NaOH - determination of energy of activation.
10. Spectrophotometric kinetics of oxidation of indigo carmine by chloramine-T (CAT) - determination of order of reaction with respect to [CAT].
11. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH_3OH).
12. Study of photolysis of uranyl oxalate (a) determination of intensity of light source (b) study of photocatalysis of oxalic acid

1. Determination of energy of activation and thermodynamic parameters (ΔH, ΔS, ΔG) for reaction between sodium format and iodine.
2. To study the kinetics of reaction between acetone and iodine-determination of order of reaction with respect to iodine and H_2SO_4.
3. Determination of mean ionic activity coefficient of a weak electrolyte (formic acid) by conduct metric measurements.
4. To study the acid catalyzed kinetics of oxidation of glycine by chloramine-T (CAT)-determination of order of reaction with respect to [CAT] and $[H^+]$.
5. Kinetics of decomposition of benzene diazonium chloride, determination of energy of activation and thermodynamic parameters.
6. To determine the eutectic point of a two component system (Naphthalene-biphenyl).
7. Conduct metric method of determination of solubility of sparingly soluble salt.
8. Study of phase diagram of a three component system (benzene-alcohol-water).
9. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH_3OH).
10. Determination of pKa value of an indicator (methyl orange).

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Practical Physical Chemistry	-	-	-	-
2	Experimental Physical Chemistry	-	-	-	-
3	Experiments in Physical Chemistry	Yadav	Geol Publishing House	-	-
RECOMMENDED BOOKS					
1	Experiments in Chemistry	D.V. Jahagirdar	Himalaya Publishing House	-	-
2	Experimental Physical Chemistry	R.C. Das and B. Behera	Tata Mc Graw Hill	-	-

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FOURTH SEMESTER

Course Title	BIOINORGANIC CHEMISTRY							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code	D0210	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

Course Objectives:

CO No.	Course Objectives
CO-1	Inorganic composition of the living cell
CO-2	Knowledge about the oxygen carriers, ion transportation across the membrane, iron sulfur proteins
CO-3	Discuss how different elements are taken up selectively by different cells and intracellular compartments and the various ways they are exploited.
CO-4	Discuss the structure and functions of complexes and materials that are formed in the biological environment.
CO-5	Knowledge about the essential, trace and toxic elements known to us and role played by them and elaborates about the toxicity and deficiency of different elements known to us

MAPPING CLO'S WITH PSO's AND CD's

CLO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Learn about the various diseases due to deficiency and excess of different elements in our body	PSO-1	Understand, remember
CLO-2	Know the mechanism of the toxicity of various metals in our body	PSO-1	Understand, remember
CLO-3	Know about the various chelating agents and their action over the metal poisoning.	PSO-1	Understand, remember
CLO-4	Know the mechanism of cisplatin in the fight against cancer	PSO-1	Understand, remember
CLO-5	Importance of biological oxygen carriers in living organisms	PSO-1	Understand, remember
CL O-6	The use of metal complexes as drugs and chemotherapeutic agents.	PSO-1	Understand, remember

Module– 1		**16hrs**
1.1	**Structural and molecular biology:** Introduction, Essential and trace metal ions in biological process, The structural building blocks of proteins, the structural building block of nucleic acids. Metal ion interactions with nucleosides and nucleotides. General features of DNA - metal complex interaction.	

1.2	**Ion transport across cell membrane:** Structure and function of biological membranes, concentration of metal ions outside and inside cells, mechanism of ion transport across cell membrane; ionophores-channel forming and carrier ionophores; active and passive transport,Na^+/K^+ pump- importance and mechanism of action.	
1.3	**Biochemistry of calcium:** Introduction - comparison of Ca^{2+} and Mg^{2+}. Biological roles of calcium, binding sites of calcium and proteins, storage of calcium, calcium in muscle contraction, calcium in blood clotting process.	
1.4	**Bioenergetics:** Introduction, Redox reactions in metabolism, the central role of ATP in metabolism. Kinetic stability of ATP, Mitochondrial flow of electrons from NADH to O_2. Oxidative phosphorylation and respiratory chain.	
1.5	**Vitamin B_{12} and Coenzymes:** Structural feature, names of different forms, chemistry of cobalamin, biochemical functions of cobalamins, model compounds. Special characteristics of B12 co-enzyme.	
1.6	**Metal ion transport and storage:** Iron storage and transport: Transferrin, ferritin, phosvitin and gastroferrin. Iron transport in microbes: siderophores, in vivo microbial transport of iron. **Keywords:** Ion transport, Bioenergetics, Vitamin B_{12}	
Module – 2		**16 hrs**
2.1	**Oxygen transport and oxygen uptake proteins:** Properties of dioxygen (O2): thermodynamic and kinetic aspects of dioxygen as an oxidant, activation of dioxygen through complexation with metal ions. Haemoglobin (Hb) and Myoglobin (Mb) in oxygen transport mechanism: Introduction to porphyrin system, substituent effects on porphyrin rings, functions of Hb and Mb. Characteristics of O2--binding interaction with Hb and Mb. Model compounds for oxygen carriers (Vaska's complex and cobalt(III) – Schiff base complexes). Hemerythrin and hemocyanin	
2.2	**Electron transport proteins and redox enzymes:** Iron – sulfur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450. Catalase and peroxidase: Structure and reactivity. **Superoxide dismutase:** Structure and reactivity.	
2.3	**Molybdenum containing enzymes**: Aspects of molybdenum chemistry, Xanthine oxidase, aldehyde oxidase, sulfite oxidase, nitrogenase and nitrite reductase.	
2.4	**Non-redox metalloenzymes** - Structure and reactivity: Carboxypeptidase-A, alcohol dehydrogenase, leucineaminopeptidase and carbonic anhydrase. **Keywords:** Hemoglobin, oxygen carriers, Redox enzymes	
Module - 3		**16hrs**
3.1	**Therapeutic uses of Metals - Metals in medicine:** Introduction, metals and human biochemistry, general requirements.	
3.2	**Disease due to metal deficiency and treatment:** Iron, zinc, copper, sodium, potassium, magnesium, calcium and selenium.	
3.3	**Metal complexes as drugs and therapeutic agents:** Introduction, Antibacterial agents, Antiviral agents, **Cancer Therapy:** Current Status and Mechanism of Action of Platinum-Based Anticancer Drugs. Non-platinum anticancer agents.	

3.4	**Gold-Based Therapeutic Agents**: A New Perspective: Uses for the treatment of rheumatoid arthritis, **Diabetes:** Vanadium and diabetes, **Metal-Based Radiopharmaceuticals**: Metal complexes as radio diagnostic agents.	
3.5	**Treatment of toxicity due to inorganics:** General aspects of mechanism of metal ion toxicity, (i) Mechanism of antidote complex with poison, rendering it inert: arsenic, lead, mercury, iron and copper. **(ii)** (ii) Antidote accelerated metabolic conversion of poison to non-toxic product: cyanide and carbon monoxide.	

References:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Bioinorganic Chemistry	A.K. Das	Books and Allied (P) Ltd,		2007
2	Bioinorganic Chemistry	K. Hussain Reddy,	New Age International		2003
3	Bioinorganic Chemistry	R.M. Roat-Malone	Wiley interscience	2nd	2007
4	Transition Metal Complexes as Drugs and chemotherapeutic Agents	N. Farrell, Kluwer	Academic publisher		1989
5	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
6	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
7	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004

Suggested readings

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicatio
1	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
2	Inorganic chemistry	Mark Weller, Tina Overton	Oxford Uiversity press	6th	2010
3	Bioinorganic Chemistry	A.K. Das	Books and Allied (P) Ltd,		2007
4	Bioinorganic Chemistry	K. Hussain Reddy,	New Age International		2003
5	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
6	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004

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Course Title	**ADVANCED SPECTROSCOPY**							
Course Type	Hard Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To identify the functional group by using IR spectra
CO-2	To know the various ionization and mass separating techniques used in mass spectroscopy
CO-3	To develop an understanding of the significance of the number, positions, intensities and splitting of signals in nuclear magnetic resonance spectra and to be able to assign structures to simple molecules on the basis of nuclear magnetic resonance spectra
CO-4	To know the significance of 13C and 2D NMR Spectroscopy
CO-5	Elucidate reaction mechanisms and Intermediates formed

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Arrange components of IR spectroscopy device, Explain working principles and taking spectrum of IR spectroscopy.	**PSO-5**	Understand and Apply
CLO-2	Identification of Functional group using IR Spectra.	**PSO-5**	Apply and Analyse
CLO-3	Apply mass spectroscopy (exact mass, and fragmentation patterns) to organic structural analysis.	**PSO-5**	Understand, Apply and Analyse
CLO -4	Interpretation of the types of organic spectra commonly used in the research setting: Mass Spectra, Infrared Spectra, 1D and 2D Nuclear Magnetic Resonance Spectra.	**PSO-5**	Understand, Apply and Analyse
CLO-5	The ability to explain common terms in NMR spectroscopy such as chemical shift ,coupling constant and anisotropy and describe how they are affected by molecular structure.	**PSO-5**	Understand
CLO-6	Learn how to use spectra to elucidate structures of organic compounds and how to solve chemical and structural problems in a systematic manner	**PSO-5**	Apply and Analyse

COURSE CONTENTS

Module 1		**16hrs**
1.1	**IR spectroscopy:** Introduction, instrumentation, sample handling, modes of vibrations, Hooks law, Characteristic group frequencies and skeletal frequencies. Finger print region, Identification of functional groups - alkenes, aromatics, cabonyl compounds (aldehydes and ketones, esters and lactones), halogen compounds, sulphur and phosphorus compounds, amides, lactums, amino acids and amines. Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain. Tautomerism, *Cis-trans* isomerism. Applications of IR spectroscopy	**8 hrs**
1.2	**Mass spectrometry:** Principles, instrumentation, different methods of ionization. EI, CI, FD and FAB, Ion separators - single focusing separator with magnetic diffraction, double focusing analyzer, time-of-fight separator and quadrupole analyzer, Mass spectra – molecular ion, base peak, meta-stable peak. General rules for fragmentation pattern. Nitrogen rule, ortho effect, Hydrogen transfer rearrangement and McLafferty rearrangement. Mass spectral fragmentation of organic compounds (acids, esters, hydrocarbons, halogenated hydrocarbons, alcohols, carbonyl compounds, amines, ethers and heterocyclic compounds). ***Key words- Fingerprint Region, Molecular Ion, Functional group Identification***	**8 hrs**
Module 2	**Nuclear magnetic resonance spectroscopy**	**16 hrs**
2.1	General introduction and definition, magnetic properties of nuclei (magnetic moment, g factor) and theory of nuclear resonance. Larmor precession frequency, resonance condition and relaxation processes. Chemical shift: Standards employed in NMR, factors affecting chemical shift, electronegativity, shielding and deshielding mechanism, van der Waals deshielding, H-bonding, diamagnetic and paramagnetic anisotropics. Spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei. Instrumentation and sample handling. Equivalence and magnetic equivalence proton exchange reactions, effects of chiral center, complex spin-spin interaction, stereochemistry, hindered rotation, Karplus curve - variation of coupling constants with dihedral angles. **Structural elucidation of simple organic molecules** ***Key words- Resonance, Chemical Shift, Anisotropy***	**16hrs**
Module- 3		**16 hrs**
3.1	**Advanced NMR:** Simplification of complex spectra: isotopic substitution, increasing magnetic field strength, double resonance, spin decoupling, contact shift reagents, FTNMR: Principle and applications, variable temperature profile, Nuclear Overhauser Effect (NOE).	**06 hrs**
3.2	**^{13}C-NMR spectroscopy**: Comparison of 1H-NMR and ^{13}C-NMR. Multiplicity – proton decoupling, noise decoupling, off resonance decoupling, selective proton decoupling, noise decoupling by FT mode, chemical shift, application of ^{13}C-NMR. NMR of ^{31}P, ^{11}B, ^{19}F and ^{15}N.	**03 hrs**
3.3	**Two dimensional NMR spectroscopy**: COSY, NOESY and magnetic resonance imaging (MRI)	**03hrs**

3.4	**Integrated structural elucidation methods:** Structural elucidation by integrated spectroscopic methods involving the spectra of UV-Vis, IR, NMR, Mass ***Key words-2D NMR, ^{13}C-NMR, NOE***	**04hrs**

60% Problems and 40% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Organic Spectroscopy	William Kemp	Pagrave Publishers, New York	3rd	1991.
2.	Spectrometric Identification of Organic Compounds	Silverstein,Bassler& Monnill	Wiley	2nd	1981
3.	Spectroscopy of Organic Compounds-	P.S.Kalsi	New Age, New Delhi	3rd	2000
4.	NMR Spectroscopy in Inorganic Chemistry,	J. A. Iggo	Oxford University Press,	-	1999
5.	Spectroscopy in Inorganic Chemistry, Vol I & II	C. N. R .Rao and J. R. Ferraro	Academic	-	1970
6.	NMR Spectroscopy Explained	Neil E. Jacobsen	John Wiley and Sons Inc	-	2007
7.	Modern NMR Spectroscopy	Jeremy K. M. Sanders	Oxford University Press	2nd	1993
8.	Basic 1H- and 13C-NMR Spectroscopy	Metin Balci	Elsevier	-	2005
9.	Comprehensive Heterocyclic Chemistry	Kartritzky series	Elsevier	-	2008
RECOMMENDED BOOKS					
1	The Sadtler Handbook of Proton NMR Spectra, Volume 1 & 2	William W. Simons	Sadtler		1978
2	Spectroscopy -Vol.2	B. P. Straughan and S. Salker	John Wiley and Sons Inc	-	1976.
3	Application of Absorption Spectroscopy of Organic Compounds	John R. Dyer	Prentice/Hall of India Private Limited, New Delhi	-	1974
4	Solving Problems with NMR Spectroscopy	Atta-ur- Rahman	Academic Press	-	1997

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THEORY-SOFTCORE

Course Title	**PHOTOCHEMISTRY, PERICYCLIC REACTIONS AND ORGANOMETALLIC CHEMISTRY**

Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code	D0340	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, available animations and charts, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	The concepts involved in understanding organic photochemical reactions, their mechanisms and applications in organic synthesis will be presented.
CO-2	Synthetic applications and mechanisms of various pericyclic reactions will be discussed.
CO-3	Different methods of analysis of pericyclic reactions to arrive at the Woodward-Hoffmann rules will be presented
CO-4	Develop basic skills for the multi-step synthesis of organic compounds
CO-5	Understanding the solution of problems related to the synthesis of organic target molecules

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Able to predict the stereochemistry & products of the Pericyclic reactions	PSO-1	Apply and Analyse
CLO-2	Envisage an organic photochemical reaction and identify the product with the type of functional group present on the molecule	PSO-5	Understand and Apply
CLO-3	Predict the course of Apply photochemistry concepts, plan and program molecules for photochemical application of specific interest	PSO-5	Understand, Apply and Analyse
CLO-4	Rationalisation of the outcome of organic reactions using mechanistic reasoning	PSO-5	Understand and Apply
CLO-5	Acquire Knowledge about various new modern organic synthetic reactions and their mechanisms involving in the formation of C-C, C-X, C=C bonds.	PSO-5	Understand and Apply

COURSE CONTENTS

Module- 1		**16hrs**
1.1	Photochemistry and concerted reactions: Introduction, light absorption and electronic transitions, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers. Photochemistry of olefins, conjugated dienes, aromatic compounds, ketones, enones, photooxidations, photoreductions, Norrish type I and II reactions, Paterno-Buchi reaction, Barton reaction, Di-pi-rearrangements.	**6hrs**
1.2	Electrocyclic reactions: Stereochemistry, symmetry and Woodward-Hofmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadiene and cyclohexadiene systems.	**3hrs**

1.3	Cycloaddition reactions: Classification, analysis by FMO and correlation diagram method. 1,3-dipolar cycloadditions: involving nitrile oxide, nitrile imine, nitrile ylide cycloaddition. Intra and intermolecular 3+2 cycloaddition and their application in organic synthesis.	**3hrs**
1.4	Cycloaddition reactions: Deils-Alder reacion, hetero Diels-Alder reaction and their applications. Sigmatropic reactions: Classification, stereochemistry and mechanisms. suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties. [3,3] and [5,5]- sigmatropic rearrangement, Claisen, Cope and aza-Cope rearrangement. Keywords:Organic photochemistry, Concerted Reactions	**4hrs**
Module- 2		**16 hrs**
2.1	Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi), organomagnesium (Grignard reagent).	**2hrs**
2.2	Organoaluminium reagents: Preparation, site selective and stereoselctive additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products.	**3hrs**
2.3	Organopalladium compounds: Suzuki coupling, Heck reaction.	**1hr**
2.4	Organotin reagents: Barton decarboxylation reaction, Barton deoxygenation reaction, Stille coupling, Stille-Kelley coupling reactions, Barton McCombie reaction, Keck stereoselective allylation and other applications.	**3hrs**
2.5	Organoboron compounds: Introduction and preparations. Hydroboration and its applications. Reactions of organoboranes: isomerization reactions, oxidation, protonolysis, carbonylation, cyanidation. Reaction of nonallylic boron stabilized carbanions: alkylation reactions, acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes).	**4hrs**
2.6	Organosulphur compounds: Introduction. Preparations, reactions, mechanism and synthetic applications of important sulphur containing reagents like dithiane, sulphur ylides etc. Organosilicon compounds: Introduction, preparations and reactions, Peterson reaction. Keywords: Named Reactions, Catalytic Cycle	**3hrs**

60% Problems(in the form of predict products) and 40% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Pericyclic Reactions – A textbook.	S. Sankararaman,	Wiley-VCH	-	2005
2	Advanced Organic Chemistry	J. March	Wiley	7th	2013
3	Advanced Organic Chemistry	F. A. Carey and R. J. Sundberg,	Plenum	3rd	1990
4	Principles of Organic Synthesis,	ROC Norman and J. M. Coxon	CRC Press	6th	1996
5	Photochemistry and Pericyclic Reactions	Jagdamba Singh, Jaya Singh	New Academic Science	-	2009
RECOMMENDED BOOKS					
1	Comprehensive Organic Synthesis	B.M. Trost and I. Fleming	Pergamon Press	-	1991

2	Advanced General Organic Chemistry	S.K. Ghosh	Book and Allied	6th	1998

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Course Title	**INORGANIC POLYMERS AND INDUSTRIAL INORGANIC CHEMISTRY**								
Course Type	Soft core - Theory		Total Hours	32	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		
			External	Duration	02 Hrs	C3	70 Marks		10

TEACHING METHODS: Industrial visit and lecture methods for gaining knowledge on the synthesis of polymers

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To know the classification, preparation and properties of polymers
CO-2	To understand the economic importance of phosphorus fertilizers.
CO-3	To learn the economic importance on inorganic fibres
CO-4	To gain the knowledge of applications of Phosphate containing polymers

MAPPING CLO'S WITH PSO'S AND CD'S

CLO	Course learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	knowledge regarding polymer science	PSO-1	Understand & Analyse
CLO-2	Economic importance on inorganic fibres	PSO-1	Understand & Analyse
CLO-3	Applications of Phosphate containing polymers	PSO-1	Remember & Understand

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	Introduction, classification, phosphate containing polymers, preparation, properties, structure. Polymers containing boron- preparation, properties, structure, degree of polymerization	**3hrs**
1.2	Borazine - Preparation, properties, structure, derivatives of borazine	**1hr**
1.3	Heterocyclic inorganic ring system: Sulphur-nitrogen ring, nitrogen-	**2hrs**
1.4	Phosphonitrilic or phosphazine polymers: Preparation, properties, structure and applications.	**2 hrs**
1.5	Silicates: Structure, classification – silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net work and applications.	**3 hrs**
1.6	Silicone: General methods of preparation, properties. Silicone polymers - silicone fluids, silicone greases, silicone resins, silicone rubbers and their	**3hrs**
1.7	Iso and heteropoly acids – of molybdenum, tungsten and vanadium, industrial applications of iso and heteropoly acids.	**2hrs**

	Keywords: Polymers, boron, Borazine, phosphazine polymers, silicated and Silicone.	
Module – 2		**16 hrs**
2.1	Inorganic fibers: Introduction, properties, classification, asbestos fibers, optical fibers, carbon fibers, Applications.	**2hrs**
2.2	Zeolites: Introduction, types of zeolites, manufacture of synthetic zeolites and	**2hrs**
2.3	Mineral fertilizers: Phosphorous containing fertilizers - Economic importance, importance of superphosphate, ammonium phosphates and their	**3hrs**
2.4	Nitrogen containing fertilizers - Importance and synthesis of ammonium sulfate, ammonium nitrate and urea.	**2hrs**
2.5	Potassium containing fertilizers - Economic importance and manufacture of potassium sulfate. Inorganic pigments: General information and economic	**2hrs**
2.6	White pigments – titanium dioxide pigments, zinc oxide pigments.	**2hrs**
2.7	Colored pigments – Iron oxide, chromium oxide, mixed-metal oxide pigments and ceramic colorants. Corrosion protection pigments, luster pigments, luminescent pigments, magnetic pigments.	**3hrs**
	Keywords: Inorganic fibers, Zeolites, Mineral fertilizers, fertilizers, White and Colored pigments	

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publicatio
1	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013
2	Basic Concepts of Inorganic Chemistry	D.N. Singh	Pearson Education,	2nd	2010
3	Inorganic chemistry	Mark Weller, TinaOverton	Oxford Uiversity press	6th	2010
4	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005
5	Advance Inorganic Chemistry	F. Albert Cotton, Geoffrey, Wilkinson	John Wiley and Sons	6th	2004
6	Inorganic Chemistry	Gary L. Miessler, Donald A. Tarr	Pearson Education	3rd	2004
7	Concise Inorganic Chemistry	J.D. Lee	Blackwell Science Ltd.,	5th	2003
8	Inorganic Chemistry	Catherine E. Housecroft And G. Sharpe Alan	Pearson Education	2nd	2003
9	Basic Inorganic Chemistry	F.A. Cotton, G. Wilkinson	John Wiley and Sons	3rd	2002
10	Inorganic Chemistry	D.F. Shriver, P.W. Atkins	Oxford University Press	2nd	1994

RECOMMENDED BOOKS

1	Inorganic Chemistry	James E. Huheey, Ellen A. Keiter,	Pearson Education	4th	2013

2	Basic Inorganic Chemistry	F.A. Cotton, G. Wilkinson	John Wiley and Sons	3rd	2002
3	Inorganic Chemistry	D.F. Shriver, P.W. Atkins	Oxford University Press	2nd	1994
4	Inorganic Chemistry	C.E. Housecroft and A.G. Sharpe	Pearson Education Ltd	2nd	2005

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Course Title	**CHEMICAL KINETICS (SC)**							
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	03	Credits	03
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Using different flow charts to study the different experimental techniques.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Correlating the concepts of kinetics through demonstration of experiments.
CO-2	Explanation of different thermodynamic variables by solving the problems.
CO-3	Illustrate the different numerical concepts involved in electrochemistry.
CO-4	Understand the role of thermodynamic cycles, availability and irreversibility.
CO-5	To state the basis for the the collision model of chemical kinetics.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Understand the role of internal energy, enthalphy, entropy and thermodynamic properties.	PSO-1	Understand, Apply and Analyse
CLO-2	Recognise and understand the different forms of pure substances.	PSO-1	Apply and understand
CLO-3	Identify and use units and notations in thermodynamics.	PSO-1	Apply, Analyse and Evaluate
CLO-4	To describe how rate laws are determined.	PSO-1	Understand, Apply and evaluate
CLO-5	To describe an activation complex or transition state.	PSO-1	Understand and Analyse
CLO-6	To identify the compounds being oxidized and reduced.	PSO-1	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	**Concepts of entropy and free energy:** Entropy as a measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies (Definition and equation).. Variation of free energy with temperature and pressure. Maxwell's relations, Nernst heat theorem .Third law of thermodynamics - calculation of absolute entropies.	**7hrs**

1.2	**Partial molar properties:** Partial molar volumes and their determination by intercept method and density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs Duhem equation. Derivation of Duhem-Margules equation.	**5hrs**
1.3	**Fugacity:** Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity co-efficient by vapor pressure, depression in freezing point and solubility measurements by electrical methods ***Key words- Entropy, Free energy, Temperature, Activity.***	**4hrs**
Module-2		**16 hrs**
2.1	**Kinetics of complex reactions:** Parallel, consecutive and reversible reactions. Determination of order of reaction. Arrhenius equation, energy of activation and its experimental determination. Potential energy surface, theoretical calculation of energy of activation. Simple collision theory - mechanism of bimolecular reaction. Lindeman's theory, Hinshelwood's theory for unimolecular reaction. Activated complex theory of reaction rate, Kinetics of reactions in solution - Salt effect, effect of dielectric constant (single sphere and double sphere model), effect of pressure, volume and entropy change on reaction rates. Kinetics of heterogeneous reactions - Langmuir's theory, unimolecular and bimolecular surface reactions. Fast reactions: Study of kinetics by flow techniques, equation for contact time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure jump methods, flash photolysis, pulse radiolysis and shock tube method. ***Key words- Kinetics , Rateequation, Collision, Theories.***	**16hrs**

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Thermodynamics for Chemists	S. Glasstone	Read books	--	2007
2	Chemical Kinetics	K.J. Laidler	Pearson	Third	2003
3	Kinetics and Mechanism of Chemical	J. Rajaram and J.C. Kuriacose	Macmillan Publishers	Reprint	2000
RECOMMENDED BOOKS					
1	Physical Chemistry	P.W. Atkins	ELBS, edition, Oxford	fourth	1990
2	Physical Chemistry	Arun Bhal and B.S. Bhal	S. Chand	13th	1963

Course Title	**SOLID STATE CHEMISTRY AND SEMICONDUCTORS; BIOPHYSICAL CHEMISTRY(SC)**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15		30 Marks		100

			External	Duration	02Hrs	C3	70 Marks	

General Objectives:
To discuss the fundamental concepts of kinetics.

TEACHING METHOD: Using different flow charts to study the different experimental techniques.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To discuss the fundamental topics of solid state chemistry and electro kinetics
CO-2	To understand various concepts of conductors and its applications
CO-3	Exploration of the fundamental relationship between electronic structure, chemical bonding, and atomic order
CO-4	Utilize band theory to describe the operation of modern semiconductor devices.
CO-5	Specify atomic planes, directions, and families of planes and directions within a given crystal structure using Miller indices

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Will learn the unique properties organic and inorganic solids have with respect to compounds in solution or in the gas phase	PSO-5	Understand, Apply and Analyse
CLO-2	Will learn the methods used to prepare, purify, and crystallize that are specific for organic and inorganic solids.	PSO-5	Apply and understand
CLO-3	Use of spectroscopic, diffraction, microscopic, thermal, and magnetic methods to characterize organic and inorganic solids	PSO-5	Apply, Analyse and Evaluate
CLO-4	Describe solid state phase relations, their chemical synthesis, and thermo dynamical and kinetic parameters reaction kinetics as well as characterization methods	PSO-5	Understand, Apply and evaluate
CLO-5	Design and development of materials with pre-required properties based on the structure of solids.	PSO-5	Understand and Analyse
CLO-6	To identify the compounds being oxidized and reduced.	PSO-5	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	Solid state chemistry: Types of imperfections, classification of imperfections, point defects, Schottky defects, Frenkel defects, disordered crystals, line defects, dislocation types, plane defects, small-angle and large-angle boundaries, stacking faults, crystal growth and twinning	**7hrs**
1.2	Semiconductors: Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, Optical properties: absorption spectrum, photoconductivity, photovoltaic effect and luminescence. Junction properties: metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.	**7hrs**

1.3	Superconductors: Meissner effect, type I and II super conductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices Key words- Crystal, semiconductor, defects	**2hrs**
Module-2		**16 hrs**
2.1	Electrokinetic phenomena: Electrophoresis - principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electroosmosis and streaming potential and its biological significance. Biological significance of Donnan membrane phenomenon. Micelles and its involvement during digestion and absorption of dietary lipids. Diffusion of solutes across biomembranes and its application in the mechanism of respiratory exchange. "Salting In" and "Salting Out" of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Effect of temperature and pH on the viscosity of biomolecules (albumin solution). Significance of viscosity in biological systems - mechanism of muscle contraction, detection of intrastrand disulfide bonds in proteins, polymerization of DNA and nature of blood flow through different vessels. Effect of temperature, solute concentration (amino acids) on surface tension. Biological significance of surface tension - stability of Alveoli in lungs, interfacial tension in living cells (Danielli and Davson model). Application of sedimentation	**16hrs**
60% Theory and 40% Problems		

REFERENCES

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Applied Biopharmacokinetics and Pharmacokinetics	Leon Shargel, Andrew YuPrentice	Hall international, Inc	Fourth	-
2	Chemical Kinetics	K.J. Laidler	Pearson	Third	2003
3	Kinetics and Mechanism of Chemical	J. Rajaram and J.C. Kuriacose	Macmillan Publishers	Reprint	2000
RECOMMENDED BOOK					
1	Essentials of Physical Chemistry and Pharmacy	H.J. Arnikar, S.S. Kadam, K.N. Gujan	Orient Longman, Bombay	-	1992

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Course Title	**CHEMISTRY OF FOOD AND BEVERAGES**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures and charts, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	The course applies basic scientific principles to food systems and practical applications.
CO-2	Chemical/biochemical reactions of carbohydrates, lipids, proteins, and other constituents in fresh and processed foods are discussed with respect to food quality.
CO-3	An Introduction to chemistry of Beverages
CO-4	Artificial and Natural Flavorings in Food Industry

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Understanding the effective usage of food and beverages	PSO-5	Understand and Apply
CLO-2	Perceptive the importance of food and beverages	PSO-5	Understand and Apply
CLO-3	Understand and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.	PSO-5	Understand, Apply and Analyse
CLO-4	To understand the principles that underlies the biochemical/enzymatic techniques used in food analysis.	PSO-5	Understand and Apply

COURSE CONTENTS

Module 1:		**16hrs**
1.1	**FOOD CHEMISTRY OF MACRONUTRIENTS** Introduction: Nature Scope and development of food chemistry, role of food chemist. Moisture in foods: Role and type of water in foods; Functional properties of water; role of water in food spoilage; Water activity and sorption isotherm; Molecular mobility and foods stability.	**4hrs**
1.2	**Dispersed systems of foods:** Physicochemical aspects of food dispersion system (sol, gel, foam, emulsions, etc); Rheology of diphasesystems Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates; Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants	**12hrs**
	Keywords: food chemistry, macronutrients, carbohydrates, Proteins, lipids and oil	
Module 2:		**16 hrs**
2.1	**PROCESSING TECHNOLOGY OF BEVERAGES** History, importance of beverages and status of beverage industry, Processing	**10hrs**

	of beverages, Packaged drinking water, juice based beverages, Synthetic, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based , alcoholic beverages fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc.; FSSAI specifications for beverages, Ingredients, manufacturing and packaging processes and equipment for different beverages	
2.2	Water treatment and quality of process water Sweeteners, colorants, acidulants, clouding and clarifying and flavouring agents for beverages Carbon dioxide and carbonation Quality tests and control in beverages; Miscellaneous beverages Coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups ***Keywords: Beverages, Processing, Artificial Sweeteners***	**6hrs**

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
	Fruit and Vegetable Juices	Tressler D.K., Joslyn M.A. and Marsh G.C.	AVI publishing company New York	-	1971
	Food and Beverage Technology International USA	Bernard and Alan	Sterling Publication	-	1989
	Food Chemistry	Owen R, Fennema	Marcel Dekker, Inc., New York, USA.	3rd	1996
	Food Chemistry	Lillian Hoagland Meyer	The AVI Publishing Co Inc., Connecticut, MA, USA.	-	1974
	Beverages: Technology, Chemistry and Microbiology	Varnam and Sutherland	Springer	-	1994
	Manufacturing of Food and Beverages	NIIR Board	NIIR Publication, New Delhi	-	-
	Essentials of Food and Nutrition Vol. II	Swaminathan M.,	Ganesh & Co.,	-	1974
	Food Flavourings	P.R. Ashust	Springer		2012
RECOMMENDED BOOKS					
1	Handbook of Alcoholic Beverages	Alan Buglass	John Wiley and Sons	-	2011
2	Preservation of Fruit and Vegetable Products	Girdharilal, Siddappa, Tondon	Indian Council of Agricultural Research Publications	-	1986
3	Biochemistry of Foods	Eskin NAM, Henderson HM and Townsed RJ	Academic Press, New York		1971

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Course Title	**CHEMISTRY IN DAY-TO-DAY LIFE**								
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To understand the concept of respiration and energy production in human body
CO-2	To outline the chemical aspects of some common health hazards
CO-3	To discuss about vitamins and minerals
CO-4	Significance of Radical chemistry in living system
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Outline the oxygen transport mechanism in body.	PSO-5	Understand and Analysis
CLO-2	Describe the mechanism of food digestion	PSO-5	Remember, and Understand.
CLO-3	Narrate the chemical aspects of some common health hazards	PSO-5	Understand and Application
CLO-4	Elaborates the importance of vitamins and minerals	PSO-5	Remember, Understand and Application
CLO-5	Gain knowledge about significance of Radical chemistry in living system	PSO-5	Understand and Application
CLO-6	Explain the action and production Chemistry of Materials	PSO-5	Understand and Analysis

COURSE CONTENTS

Module – 1		**16**
1.1	**Respiration and energy production in human body** Respiration, Respiratory enzymes, brief outline of hemoglobin and myoglobin, oxygen transport mechanism in body, co-operativity, Respiration in lower animals, hemocyanine, hemerythrine. Energy production in body, ATP; enzyme responsible for food digestion, mechanism of food digestion, active site of cytochrome c-oxidase.	**9hrs**
1.2	**Chemical aspects of some common health hazards** Anemia, sickle cell anemia, leukemia, blood pressure irregulation, blood sugar, arthritis, carbon monoxide poisoning in mines, cyanide poisoning, fluorosis etc. Key words- Respiration, enzyme and common health hazard and	**7hrs**
Module – 2		**16 hrs**

2.1	**Vitamins and minerals:** Need for vitamin in body, types of vitamins, water soluble and fat soluble vitamins, Vitamin B- 12, vitamin C (Cyanocobalamine), D, Vitamin K. Role of minerals in body, iodine deficiency and remedy.	**4hrs**
2.2	**Significance of Radical chemistry in living system** Radical production in environment, superoxide and peroxide, health impact, action of radicals, cell mutation, diseases caused by free radical, cancer, radical quencher, anti-oxidants, natural anti-oxidants like vegetables, beverages like tea and coffee, fruits. **Radical destroying enzymes:** superoxide dismutase, catalase, peroxidase, mechanism of action.	**6hrs**
2.3	**Chemistry of Materials** Soaps and Detergents – their action, Biofuels – production of biofuels and its utility as alternative fuel source, Fibers: natural fibers, cotton, wool, silk, rayon, artificial fibers, polyamides, acrylic acid, PVC, PVA; Examples of natural biodegradable polymers, cellulose, cellulose acetate, cellophane, soy protein, corn, zein protein, wheat gluten protein, synthetic biodegradable polymers. Use of polymeric materials in daily life. Key words- Vitamins, minerals, radical chemistry and chemistry of materials.	**6hrs**

100% Theory

REFERENCES

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Bioinorganic Chemistry	Kaim W	Brigitte Scwederski, Wiley	Vol 4	1994
2	Biological Inorganic Chemistry – An Introduction	Crichton R. H.	Elsevier	-	2008
3	Biochemistry	Berg J. M., Tymoczeko J. L., Stryer l.	W. H. Freeman	-	2008
4	Bioinorganic Chemistry.	Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J.	University Science Books	-	1994
RECOMMENDED BOOKS					
3	Principles of Bioinorganic Chemistry	Lippard S., Berg J. M.	University Science Books	-	1994
4	Polymer science	V. R. Gowariker, N. V.Viswanathan, J. Sreedhar	New Age International.	-	-

ABILITY ENHANCEMENT COURSES (SOFT CORE)

Course Title	**GOOD LABORATORY PRACTICES (largely Practical based)**

Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

General Objectives:

To introduce basic laboratory practices.
To prepare laboratory solutions.
To learn the technique of handling glass wares.
To gain the skill of instrumental-techniques.
To acquire knowledge about common toxic chemicals.

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand the safety measures in handling instruments.
CO-2	Prepare laboratory solutions.
CO-3	Understand the common calculations in chemistry laboratories.
CO-4	Clean and dry the glasswares
CO-5	Prepare crystals from given salt
CO-6	Acquire knowledge about common toxic chemicals

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Apply the analytical methods and techniques in environmental, research and development laboratories.	PSO-3	Understand, Apply Analyse and Evaluate
CLO-2	Gain the skill of handling and calibrating the glasswares and instruments.	PSO-3	Understand and Apply
CLO-3	Develop the meaningful problem solving analytical skills.	PSO-3	Apply, Analyse and Evaluate
CLO-4	Knowledge about safety measures in handling toxic and nontoxic chemicals	PSO-5	Understand and Apply
CLO-5	Learn laboratory preparation procedure	PSO-3	Understand and Apply
CLO-6	Evaluate the different concentration of solutions	PSO-3	Apply, Analyse and Evaluate

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COURSE CONTENTS

Module – 1		**16 hrs**
1.1	General Laboratory Practices - Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles. Preparation of solutions. Molarity and normality of common acids and bases. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling. ***Key words- Molarity, normality, molar, molal and normal solutions, common toxic chemicals.***	

Module – 2	**16 hrs**

2.1	Instrument-Techniques and laboratory preparation procedure. Use of micropipette, analytical balances, pH meter, conductivity meter, rotary evaporator, potentiometer. Use of purified water in lab experiments, Cleaning and drying of glasswares, Perpartion of crystals from given salt. Preparation of Dyes, Demonstraton of preparation of material using Sol-gel procedure. ***Key words- Instrument-Techniques, Glasswares***	

50% Theory and 50% Problems

REFERENCES

Suggested Readings

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Good Laboratory Practices: the why and how.	Seiler, J.P.	Springer-Verlag Berlin and Heidelberg GmbH & Co. K	2nd	2005
2	Good Laboratory Practice Standards: Application for field and Laboratory studies	Garner, W.Y., Barge M.S., Ussary. P.J.	Wiley VCH	8th	1992

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Course Title	**CHEMISTRY IN EVERYDAY LIFE**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Classify the different types of drugs, understand the reactivity of analgesics and analyse the adverse reaction of drugs.
CO-2	Summarize the properties, behaviour and application of various metals
CO-3	Discuss the prevention and Control of Corrosion

CO-4	Classify and elaborates the preparation, properties and uses of natural and synthetic polymers.
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Discuss the applications of antibiotics and analgesics	PSO-5	Understand and Apply
CLO-2	Describe the physical, chemical properties of metals and the applications of metals used in homes	PSO-3	Understand and Apply
CLO-3	Narrate the steps involved in prevention of corrosion in metals.	PSO-3	Understand and Analysis
CLO-4	Distinguish natural and synthetic rubber.	PSO-5	Remember, and Understand.
CLO-5	Identify the chemical poisons present in flavouring agents and food additives	PSO-3	Understand and Application
CLO-6	Gain knowledge to teach safety measures in daily life	PSO-5	Understand and Application

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	Common drugs and medicines Drug-classification, antibiotics - Applications of Penicillin, streptomycin, chloramphenicol, tetracyclins. Analgesics – Types, narcotic analgesic – morphine, apomorphine –Structure and uses.nonnarcotic analgesics – aspirin, paracetamol, analgin–Structure and uses. Burn Preparation- Chemical burn, Sun burn.Drugs in Combination, Prevention and Control of adverse reaction from drugs.	
1.2	**Metals in the service of man:** Metals: properties – physical, mechanical, metal structure and properties. Corrosion of metalsatmospheric corrosion, electrochemical corrosion. Metals commonly used in homes- iron, copper, aluminium, nickel, tin, lead, titanium, zinc and their alloys. Metals for electronics - tungsten, selenium and germanium.Precious metals - silver, gold and platinum. Key words- Pharmaceutical Industrial Applications, Metals used in Industries	

Module – 2		**16 hrs**
2.1	**Corrosion prevention and care of metals** Prevention and control of corrosion- material selection, use of corrosion resistant alloys, use of protective coatings and linings, cathodic protection, elimination of corrosive agents. Care of household metals. Metal polishes – functions, composition and mode of action of polish, general rules for cleaning and polishes. Cleaning of aluminium metals, silverware, gold, copper and brasswares.	
2.2	**Polymers** - General properties and classification. Preparation, properties and uses of PVC, Teflon and polythene. Rubber - origin and chemical nature of natural rubber, vulcanized rubber and its properties. Synthetic rubbers - neoprene rubber, Styrene Butadiene rubber [SBR] and polyurethane – structure, properties and uses.	

2.3	**Chemical poisons in food:** Sources of chemical poisons in food, toxic minerals and metals- fluoride, nitrate and selenium, natural organic toxicant in food- solanine, gossypol, oxalic acid and erucic acid, toxins in soyabean, spices , flavouring agents and fish, toxins in food from other sources, mercury, cadmium, tin and pesticide residues, food additives(polychlorinated biphenyls, N-nitroso compounds), contaminants of fats and oils. Food standards.	
	Key words- Applications of metals in day today life, Prepare a chart of polymers used in our daily life, Methods of Detecting Food Poison	

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	A text book of applied chemistry	A Thankamma Jacob	McMillan India Ltd.	First	1979
2	Fundamental concept of applied chemistry	Jayashree Gosh	S. Chand Company	-	2006
RECOMMENDED BOOKS					
3	Industrial Chemistry	B.K. Sharma	Goel Publishing House Meerut		1995

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Course Title	**CHEMOINFORMATICS**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Learn the fundementals of cheminformatics
	Understand the compounds properties and transformations
CO-2	Solve the chemical problems.
CO-3	Mention the different types of notations,
CO-4	Explain the structure descriptors and data visualization
CO-5	Elaborate the concept linear Free Energy Relations
CO-6	List out the applications of drug design

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Represent the molecules and chemical reactions	PSO-3	Understand, Apply and Analyse
CLO-2	Understand the quantitative structure activity relationship	PSO-3	Apply, Analyse and Evaluate
CLO-3	Search the chemical structures by three dimensional search methods	PSO-5	Understand, Apply and Analyse
CLO-4	Evaluate the prediction of properties of Compounds	PSO-5	Apply, Analyse and Evaluate
CLO-5	Outline the basics of computation of physical and chemical data	PSO-5	Apply, Analyse and Evaluate

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	Introduction to Chemoinformatics: History, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.	
1.2	Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.	
1.3	Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of	
1.4	Key words- Molecular Modelling, Notations, Chemical Structures, Chemical Data and Data Visualization.	

Module – 2		**16 hrs**
2.1	Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling. Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand and structure based drug design; Applications in Drug Design.	
	Key words- Applications, Quantitative Structure, Toxicity, Structure-Spectra correlations and Drug Design	

70% Theory, 30% Problems

REFERENCES

l. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	An introduction to Chemoinformatics	Andrew R. Leach and Valerie, J. Gillet	Springer: The Netherlands	-	2007
2	Chemoinformatics: A text-book.	Gasteiger, J. and Engel, T.	Wiley-VCH.	-	2003
RECOMMENDED BOOKS					
1	Molecular Modeling	QSAR	Anamaya Pub.: New Delhi	-	2011

Course Title	**RESEARCH METHODOLOGY**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Introduce the basic concepts of research.
CO-2	Explain the types of research.
CO-3	Learn the literature-review.
CO-4	Understand the importance of data collection.
CO-5	Maintain the documentation of observations

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Explain key research concepts and issues	PSO-3	Understand, Apply and Analyse
CLO-2	Identify the complex issues inherent in selecting a research problem	PSO-3	Apply, Analyse and Evaluate
CLO-3	Select an appropriate research design	PSO-5	Understand, Apply and Analyse

CLO-4	Learn the Implementation of a research project	PSO-3	Understand, Apply Analyse and Evaluate
CLO-5	Discuss the concepts and procedures of sampling, data collection, analysis and reporting.	PSO-3	Apply, Analyse and Evaluate

COURSE CONTENTS

Module – 1		**16**
1.1	Basic Concepts of Research Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs. qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.	
	Key words- Research, quantitative, qualitative and literature-review	

Module – 2		**16 hrs**
2.1	Data Collection and Documentation of Observations Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.	
	Key words- Data Collection, laboratory record, application of scale bars and field photography	

80% Theory, 20% Problems

REFERENCES

l. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Practical research methods	Dawson, C.	UBS Publishers, New Delhi	-	2002

Course Title	**WATER REMEDIATION AND CONSERVATION STUDIES**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Introduce the concept of water pollutants.
CO-2	Communicate the importance of conserving water
CO-3	Measure the current scenario of drinking water quality
CO-4	Understand how much water industry uses
CO-5	Aware of the concept water remediation
CO-6	Elaborate about terraces for water erosion control

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Appreciate the importance of saving water - and act to conserve water	PSO-5	Understand and Apply
CLO-2	Summarize the impact of industrial and human contribution towards water pollution.	PSO-3	Apply, Analyse and Evaluate
CLO-3	Elaborate the factors affecting water erosion	PSO-5	Understand and Apply
CLO-4	Conduct case study of water-shed modeling for water conservation and water quality.	PSO-3	Understand, Apply, Analyse and Evaluate
CLO-5	Acquire the knowledge of mechanics of water erosion control	PSO-3	Understand and Analyse

COURSE CONTENTS

Module – 1		**16hrs**
1.1	Water remediation: Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality, chemistry of toxicants like arsenic, fluoride, chromium, lead and mercury, cause and effects of water pollution, remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, applications of non-toxic oxides and mixed oxides, regeneration and recycling, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope	

Module – 2		**16 hrs**
2.1	Water conservation: Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control, agronomical measures of water erosion control, Terraces for water erosion control: Modeling of watershed processes, Case study of water-shed modeling for water conservation and water quality. ***Key words- Water conservation, mechanics of water erosion and case study of water-shed***.	

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Water treatment: Principles and Design MWH publication.	Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G.	MWH publication	-	-
2	Environmental Chemistry	De A. K	Wiley Eastern	-	-
3	A text book of Environmental chemistry and pollution control,	Clarson D., Dara S. S.	S Chand Co.	-	-

RECOMMENDED BOOKS					
4	Soil and water analytical method	Clarson D., Dara S. S.	S Chand Co.		
5	Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)	Edzwald J.,	-	-	-

SELF STUDY-SOFTCORE

Course Title	ETHICS AND ART OF SCIENTIFIC WRITING							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Understand the ethical norms in research
CO-2	Elaborate an overview of application to chemistry related problems
CO-3	Discuss the goal of scientific writing
CO-4	Learn the literature-review.
CO-5	Understand the importance of data collection.
CO-6	Maintain the documentation of observations

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Learn the skill of Critical Thinking	PSO-3	Understand, Apply and Analyse
CLO-2	To develop students' written expression of thought	PSO-3	Apply, Analyse and Evaluate
CLO-3	Gain the skill of power-point presentation	PSO-5	Understand, Apply and Analyse
CLO-4	Learn the process of plagiarism	PSO-3	Understand, Apply Analyse and Evaluate
CLO-5	Acquire the knowledge of Computer Literacy	PSO-3	Apply, Analyse and Evaluate
CLO-6	To provide learners opportunities to explore ideas	PSO-5	Apply, Analyse and Evaluate

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	Overview of Application to Chemistry related problems Key chemistry research areas, chemoinfomatics.	
	Key words- Research, applications Scientific methodology and chemoinformatics	

Module – 2	**16 hrs**

2.1	**Ethics and Good Practical's and Art of Scientific Writing** Authors, acknowledgements, reproducibility, plagiarism, Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Power-point presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism. Practical 1. Experiments based on chemical calculations. 2. Lab computational experiments. 3. Poster presentation on defined topics. 4. Technical writing on topics assigned. 5. Identification of different type of research in day by day life 6. Curation of relevant scientific literature from Google Scholar 7. Demonstration for checking of plagiarism using recommended software 8. Technical writing on topics assigned.	
	Key words- Ethics in science, scientific writing, plagiarism, reproducibility and scientific misconduct.	

50% Theory, 50% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Practical research methods	Dawson, C.	UBS Publishers, New Delhi	-	2002

Course Title	**SYNTHETIC ORGANIC CHEMISTRY**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code	A0330	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Using chalk and board Lecture method, chemical demonstrations, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Basic uses of reaction mechanisms.
CO-2	Familiarization about classes of organic compounds and their methods of preparation.
CO-3	Preparation and uses of various classes of organic compounds
CO-4	To understand the concepts of reaction mechanism and its applications
CO-5	Use of reagents in various organic transformation reactions

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	The ability to apply reagent knowledge	PSO-1	Understand
CLO-2	Understanding the solution of problems related to the synthesis of organic target molecules	PSO-1	Apply and Analyse
CLO-3	skills in communicating synthetic organic	PSO-1	Apply

	chemistry		
CLO-4	Evaluate the risks associated with an experiment	PSO-1	Analyse

COURSE CONTENTS

MODULE 1 :		**16hrs**
1.1	Carbon-Carbon sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity	4 hrs
1.2	Carbon-Carbon pi-bonds Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.	5 hrs
1.3	Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercurationdemercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation).	5 hrs
1.4	Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. ***Key words-Alkanes, Alkenes & Alkynes***	2 hrs
MODULE 2 : Alcohols, Phenols, Ethers and Epoxides		16 hrs
2.1	**Alcohols:** preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate.	3hrs
2.2	**Phenols:** Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.	3hrs
2.3	**Ethers and Epoxides:** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4	3hrs
2.4	**Carboxylic Acids and their Derivatives:** Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides. ***Key words- Alcohols, Phenols, Ethers, Epoxides***	7 hrs

60% Problems (in the form of Predicting products) and 40% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
	Organic Chemistry	Robert. N. Boyd and Robert Thornton Morrison	Pearson	6th	2016
	A Guide Book to Mechanism in Organic Chemistry	Petersykes	Pearson	6th	2003
	Advanced Organic Chemistry	J. March	Wiley	7th	2013
	Organic Reaction Mechanism.	R.K. Bansal,	by Wiley Eastern Limited, New Delhi,		1993
	Organic Chemistry	Marye Anne Fox,	Jones &	3rd	2004

		James K. Whitesell	Bartlett Learning	illustrated	
	Reactions, Rearrangements and Reagents	Somorendra Nath Sanyal	Bharati Bhavan	4th	2019
RECOMMENDED BOOKS					
	Principles of Organic Synthesis,	ROC Norman and J. M. Coxon	CRC Press	6th	1996.
	Advanced Organic Chemistry	F. A. Carey and R. J. Sundberg	Plenum		1990

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INTERDISCIPLINES (SOFT CORE)

Course Title	**MATERIALS SCIENCE**								
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	03	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

TEACHING METHOD: Lecture method and working model to make the concepts clear.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To learn the principles of materials science and engineering though lab investigation
CO-2	To learn the basic skills required to properly use materials science instruments
CO-3	To learn to organize the lab results into a logic, concise and accurate report
CO-4	To describe the different types of bonding in solids, and the physical ramifications of these differences.
CO-5	To review physics and chemistry in the context of materials science & engineering

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Given a type of material, be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.	PSO-5	Understand, Apply and Analyse
CLO-2	Given a type of bond, be able to describe its physical origin, as well as strength.	PSO-5	Apply and understand
CLO-3	Be able to qualitatively derive a material's Young's modulus from a potential energy curve.	PSO-5	Apply, Analyse and Evaluate
CLO-4	Given the structure of a metal, be able to describe resultant elastic properties in terms of its 1D and 2D defect	PSO-5	Understand, Apply and evaluate
CLO-5	Given a simple set of diffraction data, be able to index the peaks and infer the	PSO-5	Understand and Analyse

	structure.		
CLO-6	Be able to do simple diffusion problems.	PSO-5	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	Introduction to materials [Ref.1-3]	
1.1 1	Classification of materials - levels of structure, structure-property relationship in materials. crystalline and amorphous materials	
1.1 2	High Tc superconductors, alloys and composites, semiconductors	
1.1 3	Solar energy materials, luminescent and optoelectronic materials, polymer	
1.14	Liquid crystals and quasi crystals, ceramics-types, properties and applications	
1.2	Structure of solids [Ref.1-3]	
1.2.1	The crystalline and non-crystalline states	
1.2.2	Covalent solids, metals and alloys, ionic solids, the structure of silica and silicates	
Module-2		**16hrs**
2.1	Preparation techniques of materials [Ref.1-3]	
2.11	Single crystal growth, zone refining, epitaxial growth	
2.12	Melt-spinning and quenching methods, sol-gel, polymer processing	
2.13	Preparation of ceramic materials, fabrication, control and growth modes of organic and inorganic thin films: different techniques of thin film preparations -	
2.2	Synthesis of nanomaterials	
2.21	Top down and bottom up approaches of synthesis of nano-structured materials	
2.22	Nanorods, nanotubes/wires and quantum dots	
2.23	Fullerenes and tubules, single wall and multiwall nanotubes	
Module-3		**16hrs**
3.1	Phase Transistion	
3.11	Solid phases and phase diagrams [Ref.1-3]	
3.12	Single and multiphase solids, solid solutions and Hume-Rothery rules	
3.13	Intermediate phase, the intermetallic and interstitial compounds	
3.14	Properties of alloys: solid solutions and two component alloy systems	
3.15	Phase diagram, Gibbs phase rule, lever rule- first, second and third order phase	
3.16	Some typical phase diagrams: Pb-Sn and Fe-Fe2O3, eutectic, eutectoid,	
3.17	Order disorder phenomenon in binary alloys, long range order, super lattice,	
3.2	Phase transformation	
3.21	Time scale for phase changes	
3.22	Nucleation and growth, nucleation kinetics, growth and overall transformation	
3.23	Applications - transformation in steel- precipitation processes, solidification and	

60% Theory and 40% Problems

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication

1	Elements of Materials Science and Engineering	Van Vlack L. H.,	Addison Wesley	6th Edn	1989.
2	Materials Science and Engineering	Raghvan V	Prentice Hall of India,	5th Edn	2009.
3	Engineering Materials	Budinski K. G. and Budinski M. K.,	Prentice-Hall of India Pvt. Ltd,	8th Edn	2004
RECOMMENDED BOOKS					
1	Materials Science and Engineering	Raghvan V	Prentice Hall of India,	5th Edn	2009.
2	Engineering Materials	Budinski K. G. and Budinski M. K.,	Prentice-Hall of India Pvt. Ltd,	8th Edn	2004

Course Title	**PHARMACOLOGY OF PLANT PRODUCTS**								
Course Type	Soft Core- Theory		Total Hours	48	Hours/Week	03	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

Teaching Method: Using chalk and board Lecture method, charts, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	The course provides a brief introduction to plant systematics.
CO-2	Significant poisonous and medicinal plants, together with natural medicines, will be discussed.
CO-3	Important classes of compounds (secondary metabolites) in and from nature will be emphasised, and stress will be put on classification, nomenclature, structure, biosynthesis, occurrence, analysis and pharmaceutical perspectives.
CO-4	Pharmacokinetics and Pharmacodynamics
CO-5	
CO-6	

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Learn the constituent present in crude drugs responsible for Pharmacological action.	PSO-2	Understand
CLO-2	Learn various biopharmaceutic factors affecting drug bioavailability	PSO-2	Understand and Apply
CLO-3		PSO-2	Understand and apply
CLO-4	Determine and define drugs from natural origin.	PSO-2	Apply
CLO-5	To impart academic and knowledge of clinical practice in Ayurvedic drugs	PSO-2	Apply

COURSE CONTENTS

Module -1.	Introduction to basic concepts of pharmacology	**8hrs**
1.1	Definition	
1.2	Sources of drugs & routes of drugs administration	
1.3	Therapeutic drug monitoring system-Basic principles of TDM	
1.4	Therapeutic index	
1.5	Prodrug concepts	
Module -2	Plant products as drugs	**8hrs**
2.1	Historical aspects of plant usage	
2.1.1	Whole plants	
2.1.2	Plant extracts	
2.1.3	Tinctures	
2.1.4	Teas	
2.1.5	Portions	
2.1.6	Ayurveda and plants	
Module- 3	Secondary Metabolites and their Roles in Plant Physiology and as alternative Medicine	**8hrs**
3.1	Terpenes	
3.2	Phenols	
3.3	Tannins	
3.4	Flavonoids	
3.5	Alkaloids	
3.6	Nitrogenous Compounds	
Module-3	Extraction and characterization of bioactive components from plants	**5hrs**
4.1	Biochemical action of some phytochemicals	
4.1.1	Quercetin	
4.1.2	Ellagic Acid	
4.1.3	Curcumin	
4.2	Plants for treatment of diseases	
4.2.1	Diabetes	
4.2.2	CVD	
4.2.3	Alzheimers	
4.2.4	Cancers	
Module-5		**3hrs**
5.	Drug delivery systems	
5.1	sustained release	
5.2	enteric coated formulations liposome and nanoparticles	
Module- 6	Pharmacokinetics	**8hrs**
6.1	Basics of pharmacokinetics	
6.2	calculation of pharmacokinetic estimates	
6.3	Compartment models used in pharmacokinetics (oral and intravenous)	
6.4	Compartment fitting (one comp & two comp)	

6.5	Pharmcodynamic /pharmacokinetic (PK/PD) correlation	
Module-7	Pharmacodynamics	**8hrs**
7.1	Types of action	
7.2	Mechanism of drug action	
7.3	Drug receptor interaction with examples	
7.3.1	Agonist	
7.3.2	Antagonist	
7.3.3	Partial Agonist	
Module -8	Clinical Trials	**8hrs**
8.1	Clinical evaluation of new drug	
8.2	Phases of clinical trail	
8.3	Ethics and protocol	
8.4	Preparation of clinical trail	
8.5	New drug development process and drugs registration	
Module- 9	AYUSH and ayurvedic drugs	
Module- 10	Pre-clinical pharmacokinetic and dynamic studies	**8hrs**
10.1	Lipinski's rule for drug like molecule	
10.2	High throughput screening (invitro and invivo) for pre-clinical pharmacokinetic and pharmacodynamic studies	

15% Problems and 85% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Textbook of Pharmacology	Barar F S K	S Chand & Company	1st	2012
2.	Text Book of Phytochemistry	Iqbal A		-	1993
3.	Pharmacognosy and Phytochemistry:	Vinod D. Rangari		-	2009
4.	Medicinal Plants	V. K. Gupta , Dr. Anpurna Kaul & Surjeet Singh		2nd	2012
5.	Medicinal Plants: Chemistry, Pharmacology, and Therapeutic Applications	Mallappa Kumara Swamy, Jayanta Kumar Patra, Gudepalya Renukaiah Rudramurthy	CRC Press, Taylor & Francis Group	-	2019
6.	Medical Pharmacology	Padmaja Udaykumar			2009

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Course Title	**CHEMISTRY IN DAY-TO-DAY LIFE**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To understand the concept of respiration and energy production in human body
CO-2	To outline the chemical aspects of some common health hazards
CO-3	To discuss about vitamins and minerals
CO-4	Significance of Radical chemistry in living system
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Outline the oxygen transport mechanism in body.	PSO-5	Understand and Analysis
CLO-2	Describe the mechanism of food digestion	PSO-5	Remember, and Understand.
CLO-3	Narrate the chemical aspects of some common health hazards	PSO-5	Understand and Application
CLO-4	Elaborates the importance of vitamins and minerals	PSO-5	Remember, Understand and Application
CLO-5	Gain knowledge about significance of Radical chemistry in living system	PSO-5	Understand and Application
CLO-6	Explain the action and production Chemistry of Materials	PSO-5	Understand and Analysis

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	**Respiration and energy production in human body** Respiration, Respiratory enzymes, brief outline of hemoglobin and myoglobin, oxygen transport mechanism in body, co-operativity, Respiration in lower animals, hemocyanine, hemerythrine. Energy production in body, ATP; enzyme responsible for food digestion, mechanism of food digestion, active site of cytochrome c-oxidase.	**9hrs**

1.2	**Chemical aspects of some common health hazards** Anemia, sickle cell anemia, leukemia, blood pressure irregulation, blood sugar, arthritis, carbon monoxide poisoning in mines, cyanide poisoning, fluorosis etc. ***Key words- Respiration, enzyme and common health hazard and***	**7hrs**

Module – 2		**16 hrs**
2.1	**Vitamins and minerals:** Need for vitamin in body, types of vitamins, water soluble and fat soluble vitamins, Vitamin B- 12, vitamin C (Cyanocobalamine), D, Vitamin K. Role of minerals in body, iodine deficiency and remedy.	**4hrs**
	Significance of Radical chemistry in living system Radical production in environment, superoxide and peroxide, health impact, action of radicals, cell mutation, diseases caused by free radical, cancer, radical quencher, anti-oxidants, natural anti-oxidants like vegetables, beverages like tea and coffee, fruits. **Radical destroying enzymes:** superoxide dismutase, catalase, peroxidase, mechanism of action.	**6hrs**
2.2	**Chemistry of Materials** Soaps and Detergents – their action, Biofuels – production of biofuels and its utility as alternative fuel source, Fibers: natural fibers, cotton, wool, silk, rayon, artificial fibers, polyamides, acrylic acid, PVC, PVA; Examples of natural biodegradable polymers, cellulose, cellulose acetate, cellophane, soy protein, corn, zein protein, wheat gluten protein, synthetic biodegradable polymers. Use of polymeric materials in daily life. ***Key words- Vitamins, minerals, radical chemistry and chemistry of materials.***	**6hrs**

100% Theory

REFERENCES

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Bioinorganic Chemistry	Kaim W	Brigitte Scwederski, Wiley	Vol 4	1994
2	Biological Inorganic Chemistry – An Introduction	Crichton R. H.	Elsevier	-	2008
3	Biochemistry	Berg J. M., Tymoczeko J. L., Stryer l.	W. H. Freeman	-	2008
4	Bioinorganic Chemistry.	Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J.	University Science Books	-	1994
RECOMMENDED BOOKS					
3	Principles of Bioinorganic Chemistry	Lippard S., Berg J. M.	University Science Books	-	1994
4	Polymer science	V. R. Gowariker, N. V.Viswanathan, J. Sreedhar	New Age International.	-	-

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SKILL ENHANCEMENT COURSES

Course Title	**MATHEMATICAL METHODS IN CHEMISTRY**								
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	03Hrs	C3	70 Marks		

TEACHING METHOD: Theory based mathematical computation along with better knowledge of the chemistry

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Fundamentals of mathematics
CO-2	Uncertainties along with statistical treatment
CO-3	Mathematical and algebraic operation
CO-4	Mathematical series, Pythagoras theorems and such others
CO-5	Differential amd integral calculus in the modern technology and science

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Mathematical operation and functions	PSO-1	Understand, Apply and Analyse
CLO -2	Statistical treatment	PSO-5	Understand, Apply and Analyse
CLO -3	Roots of quadratic equations analytically and iteratively	PSO-5	Analyse and Evaluate
CLO -4	Differential calculus	PSO-5	Understand, Apply and Analyse
CLO -5	Integral calculus	PSO-1	Understand, Apply and Analyse

COURSE CONTENTS:

Module -1		**16 hrs**
1.1	Fundamentals of mathematics Mathematical functions, polynomial expressions, logarithms, exponential function, Modules of a measurement, inter-conversion of Modules, constants and variables, equation of a straight line, plotting graphs, data representation, pi-charts, histogram. Uncertainty in experimental techniques: Displaying uncertainties and measurements in chemistry, decimal places, significant figures, combining quantities.	**03 hrs**
1.2	Uncertainties in measurement: types of uncertainties, combining uncertainties. Use of statistical tools, Data reduction and the propagation of errors, binomial, Poisson and Gaussian distributions, Graphical and numerical data reduction. Numerical curve fitting: the method of least squares (regression).	**02 hrs**
1.3	Algebraic operations on real scalar variables, Roots of quadratic equations analytically and iteratively, Numerical methods of finding roots (Newton-Raphson, binary –bisection).	**06hrs**
1.4	Mathematical series: Power series, Maclaurin, Taylor series, convergence (e.g. pressure virial equation of state, colligative properties). Pythagoras theorem in three dimensions. Trigonometric functions, identities.	**05 hrs**
	Keywords: Functions, uncertainties, mathematical series	

Module-2		**16 hrs**
2.1	Differential calculus: The tangent line and the derivative of a function, numerical differentiation, differentials of higher order derivatives, discontinuities, stationary points, maximum-minimum problems, inflexion points, limiting values of functions: L'Hopital's rule, combining limits.	**04 hrs**

2.2	Calculus of several variables: Functions, change of variables, total differential, chain rule, partial differentiation, Euler's theorem, exact and inexact differentials (applications tin the domains of thermodynamics, surface chemistry), line/surface-integrals.	**04 hrs**
2.3	Integral calculus: Integration, odd-even functions, indefinite integrals, standard integrals, methods of integration (by parts, substitution, partial fractions and others. Examples from kinetics, thermodynamics, nuclear chemistry and surface chemistry, numerical integration (Trapezoidal and Simpson rules, e.g. entropy/enthalpy change from heat capacity data), probability distributions and mean values. Tri-gonometric functions (applications in chemistry need to be emphasized throughout)	**08 hrs**
	Keywords: Differential and integral calculus	

100 % problematic approach

REFERENCES:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Chemical Maths Book	E. Steriner	Oxford University Press	1st	1996
2	Maths for Chemists	M. C. R. Cockett and G. Dogget	Royal Society of Chemistry, Cambridge	1st	2003

Course Title	**INDUSTRIAL CHEMISTRY**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	02 Hrs	C3	70 Marks	

TEACHING METHOD: Theory based with practical outcome with field based visit to chemical industries

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Composition, manufacture and setting of cement and ceramics
CO-2	Composition and finishing of glass and matches
CO-3	Synthesis and classification of dyes , pigments and paints
CO-4	Plastic and fibres-its classification and properties along with its uses
CO-5	Fertilizers and fuels

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CLO-1	Gaining knowledge of industrial products	PSO-1	Understand
CLO-2	Understanding the manufacture procedures of industrial products of high importance	PSO-5	Understand and apply
CLO-3	Understanding the importance of industrial chemistry for social	PSO-5	Understand and apply

	reformation		
CLO-4	Knowing the application of chemistry to optimise the production and protection of environment	PSO-5	Apply and Analyse
CLO-5	Understanding various methods to improve industrial processes.	PSO-1	Apply, analyse and evaluate

COURSE CONTENTS:

Module -1		**16 hrs**
1.1	Cement and Ceramics: Cement –Composition- Types -Portland cement – Composition- Types-Manufacture (Wet and Dry process)-Uses -Setting of cement-Ceramics-Composition-Classification-Manufacture-Properties-Uses	**05 hrs**
1.2	Glass and Matches Glass-Composition-Types-Formation operations-Melting-Blowing-Pressing-Annealing and finishing-Matches-Composition-Types-Manufacture-Safety matches	**05 hrs**
1.3	Pigments, Dyes and Paints Pigments-Classification-Manufacture-Uses-Dyes-Classification-Preparation-Dyeing processes-Paints-Composition-Types-Manufacture-Testing of Paints	**06 hrs**
	Keywords: Cement, ceramics, glass, dyes and pigments	

Module-2		**16 hrs**
2.1	Plastics and Fibres Fibres-Natural-Syntheticfibres-Artificialsilk-Rayon-Nylon-Trylene-Composition Classification-Manufacture-Properties-Uses	**08 hrs**
2.2	Fertilizers and Fuels Fertilizers -Organic fertilizers-Inorganic fertilizers-Preparation-Uses-Fuels-Energy resources-Industrial gases-Water gas-Producer gas-Oil gas-Natural gas-Coal gas-Gobar gas-Indane gas-Petroleum products and coal products.	**08 hrs**
	Keywords: Plastics, fibres, fertilizers and fuels	

100 % industry based knowledge

REFERENCES:

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	Industrial Chemistry	B.K. Sharma	Goel Publishing house, Meerut.	16^{th}	2011
2	Industrial Chemistry	R.K. Das	Asia Publishing House	10^{th}	2008
3	Chemistry for environmental engineering and science	C.N. Sawyer, P.L. McCarty and G.S. Parkin	McGraw-Hill Series	5^{th}	2017
4	Text Book of Polymer Science	F. W. Bilmayer	John Wiley & Sons	3^{rd}	2007

5	The Elements of Polymer Science and Engineering	A. Rudin	Science direct	3rd	2013
6	Polymer Science and Technology of Plastics and Rubbers	P. Ghosh	McGraw-Hill Series	3rd	2011

Course Title	**FOOD AND PHARMACEUTICAL ANALYSIS**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code	C0310	Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD:
Sampling and analysis of various components present in the food and pharmaceutical samples

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Sampling of food
CO-2	Sampling of beverages and preservation
CO-3	Detection and determination of contents of food and beverages
CO-4	Quality control of drugs
CO-5	Analytical assay methodology for common drugs such as analgesics, antibiotics, Antiallergies, Antimalarials, Antituberculosists

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	**Course Learning Outcomes**	**PSOs Addressed**	**Cognitive Level**
CLO-1	Sampling of food	PSO-5	Remember, and Understand
CLO-2	Qualitative and quantitative analysis of food	PSO-5	Remember, Apply, and Analyse
CLO-3	Sampling of drugs	PSO-5	Remember, and Understand
CLO-4	Qualitative and quantitative analysis of pharmaceutical samples	PSO-5	Remember, Apply, and Analyse

COURSE CONTENTS:

Module-1		**16 hrs**
1.1	Food analysis: Objectives of food analysis. Sampling procedures. Detection and determination of sugars and starch. Methods for protein determination. Oils and fats and their analysis – iodine value, saponification value and acid value. Rancidity - detection and determination (peroxide number). Tests for common edible oils. Analysis of foods for minerals - phosphorus, sodium, potassium and calcium. General methods for the determination of moisture, crude fibre and ash contents of food. Analysis of milk for fat and added water.	**08**

1.2	Non-alcoholic beverages -determination of chicory and caffeine in coffee; - caffeine and tannin in tea. Alcoholic beverages - methanol in alcoholic drinks and chloral hydrate in toddy. Food additives - chemical, preservatives - inorganic preservatives sulphur dioxide and sulphites, their detection and determination. Organic preservatives - benzoic acid and benzoates, their detection and determination. Flavouring agents - detection and determination of vanilla and vanillin. Coloring matters in foods - classification, certified colors, detection of water soluble dyes, color in citrus fruits, beet dye in tomato products, mineral color. Pesticide residues in foods - determination of chlorinated organic pesticides. Control food quality - codex alimentarius, Indian standards.	**08**

Module - 2		**16hrs**
2.1	Drugs and pharmaceutical analysis: Importance of quality control; drugs and pharmaceuticals. Sources of impurities in pharmaceutical chemicals. Analytical quality control in finished/final products.	**08**
2.2	Common methods of assay. Analysis of common drugs; Analgesics - aspirin, paracetamol; Anthelmintics - mebendazole; Antiallergies - chlorpheneramine malleate; Antibiotics - penicillin, chloromecytin; Anti-inflammatory agents - oxyphenbutazone; Antimalarials - primaquine phosphate; Antituberculosists - INH; Narcotics - nicotine, morphine; Expectorants - Benadryl; Sedative - diazepam; Vitamins - A. C, B1, B2, B6, niacin and folic acid. Estimation of drug residues in biological samples.	**08**

100% theory

REFERENCES:

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of Publication
01	Analytical Agricultural Chemistry	S.L. Chopra and J.S. Kanwar	Kalyani Publishers, New delhi	1st	1999
02	Pharmaceutical Analysis	T. Higuchi and E.B. Hanssen	John Wiley and Sons	1 st	1997
03	Quantitative Analysis of Drugs in Pharmaceutical Formulations	P. D. Sethi	CBS Publishers and Distributors by New Delhi	3rd	1997
04	A First Course in Food Analysis	A.Y. Sathe	New Age Internationals (P) Ltd, Bangalore	1st	1999

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Course Title	**CHEMISTRY IN DAY-TO-DAY LIFE**								
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and

group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To understand the concept of respiration and energy production in human body
CO-2	To outline the chemical aspects of some common health hazards
CO-3	To discuss about vitamins and minerals
CO-4	Significance of Radical chemistry in living system
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Outline the oxygen transport mechanism in body.	PSO-5	Understand and Analysis
CLO-2	Describe the mechanism of food digestion	PSO-5	Remember, and Understand.
CLO-3	Narrate the chemical aspects of some common health hazards	PSO-5	Understand and Application
CLO-4	Elaborates the importance of vitamins and minerals	PSO-5	Remember, Understand and Application
CLO-5	Gain knowledge about significance of Radical chemistry in living system	PSO-5	Understand and Application
CLO-6	Explain the action and production Chemistry of Materials	PSO-5	Understand and Analysis

COURSE CONTENTS

Module – 1		**16**
1.1	**Respiration and energy production in human body** Respiration, Respiratory enzymes, brief outline of hemoglobin and myoglobin, oxygen transport mechanism in body, co-operativity, Respiration in lower animals, hemocyanine, hemerythrine. Energy production in body, ATP; enzyme responsible for food digestion, mechanism of food digestion, active site of cytochrome c-oxidase.	**9hrs**
1.2	**Chemical aspects of some common health hazards** Anemia, sickle cell anemia, leukemia, blood pressure irregulation, blood sugar, arthritis, carbon monoxide poisoning in mines, cyanide poisoning, fluorosis etc. ***Key words- Respiration, enzyme and common health hazard.***	**7hrs**

Module – 2		**16 hrs**
2.1	**Vitamins and minerals:** Need for vitamin in body, types of vitamins, water soluble and fat soluble vitamins, Vitamin B- 12, vitamin C (Cyanocobalamine), D, Vitamin K. Role of minerals in body, iodine deficiency and remedy.	**4hrs**

2.2	**Significance of Radical chemistry in living system** Radical production in environment, superoxide and peroxide, health impact, action of radicals, cell mutation, diseases caused by free radical, cancer, radical quencher, anti-oxidants, natural anti-oxidants like vegetables, beverages like tea and coffee, fruits. **Radical destroying enzymes:** superoxide dismutase, catalase, peroxidase, mechanism of action.	**6hrs**
2.3	**Chemistry of Materials** Soaps and Detergents – their action, Biofuels – production of biofuels and its utility as alternative fuel source, Fibers: natural fibers, cotton, wool, silk, rayon, artificial fibers, polyamides, acrylic acid, PVC, PVA; Examples of natural biodegradable polymers, cellulose, cellulose acetate, cellophane, soy protein, corn, zein protein, wheat gluten protein, synthetic biodegradable polymers. Use of polymeric materials in daily life. ***Key words- Vitamins, minerals, radical chemistry and chemistry of materials***.	**6hrs**

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of Publication
1	Bioinorganic Chemistry	Kaim W	Brigitte Scwederski, Wiley	Vol 4	1994
2	Biological Inorganic Chemistry – An Introduction	Crichton R. H.	Elsevier	-	2008
3	Biochemistry	Berg J. M., Tymoczeko J. L., Stryer l.	W. H. Freeman	-	2008
4	Bioinorganic Chemistry.	Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J.	University Science Books	-	1994
RECOMMENDED BOOKS					
3	Principles of Bioinorganic Chemistry	Lippard S., Berg J. M.	University Science Books	-	1994
4	Polymer science	V. R. Gowariker, N. V.Viswanathan, J. Sreedhar	New Age International.	-	-

Course Title	**GREEN CHEMISTRY**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures and charts, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To understand Anastas' twelve principles of green chemistry
CO-2	To learn the microwave mediated organic synthesis
CO-3	An Introduction to chemistry of Beverages
CO-4	Artificial and Natural Flavorings in Food Industry

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Explain the tools of green chemistry.	PSO-5	Understand
CLO-2	Practical Application of Green Protocols in organic synthesis	PSO-5	Understand and Apply
CLO-3	Understand the alternative synthesis, reagents and reaction conditions	PSO-1	Understand, Apply and Analyse
CLO-4	List out the applications of green oxidants	PSO-5	Understand and Apply

COURSE CONTENTS

Module – 1		**16hrs**
1.1	Introduction to green chemistry: Green chemistry-relevance and goals, Anastas' twelve principles of green chemistry - Tools of green chemistry: alternative starting materials, reagents, catalysts, solvents and processes with suitable examples.	**7hrs**
1.2	Microwave mediated organic synthesis (MAOS): Microwave activation – advantage of microwave exposure – specific effects of microwave – Neat reactions – solid supports reactions _ Functional group transformations – condensations reactions – oxidations – reductions reactions – multi-component reactions. Keywords: Green Solvents, Microwave assisted Organic Synthesis	**9hrs**
Module – 2		**16hrs**
1.1	Alternative synthesis, reagents and reaction conditions: Introduction – synthesis of ionic liquids – physical properties – applications in alkylation –hydroformylations – expoxidations – synthesis of ethers – Friedel-craft reactions – Diels-Alder reactions – Knoevengal condensations – Wittig reactions – Phase transfer catalyst - Synthesis – applications. A photochemical alternative to Friedel-crafts reactions - Dimethyl carbonate as a methylating agent – the design and applications of green oxidants – super critical carbon dioxide for synthetic chemistry. Keywords: Alternative Reagents, Solvent less Reaction	**16 hrs**

30% Problems(in the form of named Reactions) & 70% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of Publication
1.	Green Chemistry – Designing Chemistry for the Environment	Paul T. Anastas & Tracy C. Williamson	Oxford University Press	Second	1998

2.	Green Chemistry – Frontiers in benign chemical synthesis and processes	Paul T. Anastas & Tracy C. Williamson.,	Oxford University Press		1998
3.	Green Chemistry – Environment friendly alternatives-	Rashmi Sanghi & M. M. Srivastava, , ()	Narora Publishing House		2003
4.	Green Chemistry Environmentally benign reactions	V. K. Ahluwalia	Ane Books India	-	2006
5.	Green Chemistry : A Textbook	V. K. Ahluwalia	Narosa Publishing House	-	2013
RECOMMENDED BOOKS					
1	Alternative Energy Sources for Green Chemistry	Andrzej Stankiewicz, Georgios Stefanidis	RSC Cambridge	-	2016
2	Microwave-Assisted Organic Synthesis: A Green Chemical Approach	Suresh C. Ameta, Pinki B. Punjabi, Rakshit Ameta, Chetna Ameta	CRC Press	-	2014

Course Title	**AGRICULTURAL CHEMISTRY**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures and charts, assignments, seminars and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Recognize the chemical composition and physical properties of soil.
CO-2	Understand the classification, structure, action and toxicology of pesticides, herbicides and fungicides
CO-3	Explain the types of fertilizers and their action on soil.
CO-4	Explain the types of manures and the method of composting

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Inculcation of scientific approach to farming	PSO-5	Understand
CLO-2	Analyze the soil for its fertility and productivity	PSO-5	Apply
CLO-3	Outline the importance of green manures and their applications	PSO-5	Apply
CLO-4	Understanding pest and weed	PSO-5	Understand and

	management		Apply

COURSE CONTENTS

Module – 1		**16hrs**
1.1	**Soil chemistry –** Definition, components of soil, soil forming minerals, soil forming rocks, Weathering of rocks and minerals **Soil reaction:** Soil pH, factors controlling soil reaction, influence of soil reaction on availability of nutrient, buffering. Acid soil – Nature of soil acidity, development and formation of acid soils, effect of acidity on plants. **Macro and micro plant nutrients** – Nutrient functions of N, P, K, Ca, Mg, Mn, Zn, on soil.	**5hrs**
1.2	**Pesticides** –classification –organochlorine compounds-DDT, BHC, Lindane. **Organophosphorus compounds** – Malathion, Dichlorvos, Parathion – Structure, action, toxicology and health risks. **Herbicides** - classification –Triazines, Bipyridyls, Diuron. **Fungicide**- Hexachlorobenzene, Bordeaux mixture - structure, toxicology and health risks.Biodegradation of pesticides – Advantages and disadvantages of pesiticidal use. ***Keywords:*** *Herbicides, Fungicides & Pesticides*	**11hrs**
Module – 2		**16hrs**
2.1	**Fertilizer-** Definition, functions of essential nutrients, types of fertilizers-fertility index, nitrogenous fertilizers-urea and ammonium sulphate-effect of nitrogen on plant growth and development. **Phosphate fertilizers**-Effect of phosphorous on plant growth and development – classification – super phosphate, rock phosphate, potassium fertilizers – function of potassium on plant growth. **Mixed fertilizers –** effect of mixed fertilizers on soil pH – movement of fertilizer salts in the soil.	**10 hrs**
	Green manures – green leaf manure – bulky organic and concentrated **Organic manures** – composting of coir pith, sugarcane trash, oil cakes, bone meal, fish meal manure. **Animal manure** – chemical composition, storage treatment and management, agricultural utilization. Industrial and organic waste manures – types ,sewage effluent and sludge Art, Science and business of crop production-Factors affecting crop production-Brief history of agricultural development:- Chronological Agricultural Technology development in India. Indian Agriculture and Dry land agriculture ***Keywords: Fertilizers and Manures.***	**6hrs**

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1.	Environment Chemistry	De A.K.	New age International pvt. Ltd.	3rd	1999

2.	The Nature and properties of Soil	Nyle C. Brady	Mcmillan Publishing company	10th	1996
3.	Fundamentals of Environmental Pollution	Krishnan kannan	S.Chand and company Ltd.	-	1997
4.	Biodiversity and Conservation	Joshi P.C. and Namitha Joshi	APH Publishing Corporation	-	2004
5.	Fundamental of soils	Sashai V.N	Kalyani Publishers	2nd	1993
RECOMMENDED BOOKS					
1	A Text book of Applied Chemistry	Thankamma jacob A.	McMillon Company of India Ltd.	-	1979
2	Principles of Environmental Chemistry	Kothandaraman .H and Geetha Swaminathan	B. I. Publications Pvt. Ltd	-	1997
3	Soil environment and pesticides	Prasad . D. Gaur .H.S	Venus publishing House.	1st	1994
4	Environmental Chemistry	Sharma B.K	Goel Publishing	8th	2005
5	History of Agriculture in India, Vol.I-IV –(Ed.)	M.S.Randhawa	-	-	-

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Course Title	**COMPUTER APPLICATIONS IN CHEMISTRY (SC)**								
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits		02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks		100
			External	Duration	02Hrs	C3	70 Marks		

TEACHING METHOD: Understanding the different concepts of Chemistry through handson.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	The course aims to develope competences of students in using computers to solve problems related to Chemistry.
CO-2	The aim of this course is to acquaint the student with application of computers in chemistry
CO-3	Online Chemistry literature searching, data bases, applications of computer in statistics, application specific computer programs in chemistry.
CO-4	The use of different methods to assess the student and to the development of various skills and give them a chance to prove their ability in development
CO-5	Compare the course contents with other regional or global universities.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Demonstrate the various Menus and its	PSO-2	Understand, Apply

	operating usage in Ms Word.		and Analyse
CLO-2	Creation of various slides with different formats with the help of Ms PowerPoint.	PSO-2	Apply and understand
CLO-3	Write up Ms Excel along with practical usage like preparation of final accounts by using formulae and different types of charts.	PSO-2	Apply, Analyse and Evaluate
CLO-4	Formation of payroll for employee and creation of forms and reports by using Ms Access.	PSO-2	Understand, Apply and evaluate
CLO-5	Preparation of trial balance, profit and loss account and balance sheet by adopting Tally.	PSO-2	Understand and Analyse
CLO-6	Learn to use search engines and visit various websites.	PSO-2	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
.1.1	Spreadsheet Applications: Introduction of spreadsheet (MS Excel), application, formulas and functions, performing basic statistics using spreadsheet applications, creating basic graphs using spreadsheet applications, logical (Boolean) operators	**8hrs**
1.2	Internet Resources Advanced Google search operators and Boolean functions, Introduction to Google Scholar and accessing scholarly literature from Internet, Fake News and spotting the fake news, multimedia resources and podcasts, RSS/XML Feeds and feed subscription using a feed reader. Key Words: Spreadsheet, Google search, Subscription	**8hrs**
Module-2		**16 hrs**
2.1	Other software resources Introduction to advanced functions of MS Word and its Open Office substitutes including tracking changes, inserting page numbers and automatic table of contents, Google Docs and Forms, MS Power point, Microphotography and scale calibration with ImageJ, digital image processing (Paint.net or GIMP).	**8hrs**
2.2	Bibliography management Introducing a bibliography management software (for e.g. Endnote), Styles and Templates, Changing the bibliography style as per journal format, Citing while typing in the office application, downloading citations from Google Scholar. Key Words: Bibliography, MS office, Image processing	**8hrs**

SUGGESTED READINGS	
1.	User manual and online user manual of respective soft wares for the most updated content
2.	Published books are not recommended as versions keep on updating very frequently; therefore, it is not easy to follow

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Course Title	**ANALYTICAL CLINICAL BIOCHEMISTRY(SC)**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	03	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15		30 Marks		100

			External	Duration	02Hrs	C3	70 Marks	

TEACHING METHOD: The course includes teaching, theoretical lessons and Laboratory tutorials; if necessary, for lab tutorials students will be divided into groups. If possible, will be carried out technical visits to hospital laboratories.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To impart knowledge of methods and techniques for biomolecules separation and purification.
CO-2	Student will be able to correlate all patient test data for acceptability: Review normal physiology and function.
CO-3	Student will be able to interpret patient test results using reference intervals and previous patient data
CO-4	Recognize pathophysiology of abnormal results.
CO-5	Explain recommended patient preparation protocol, specimen requirements, and abnormal serum appearance when collecting or handling specimens for lipid analysis.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Discuss the fundamental biochemistry knowledge related to health	PSO-3	Understand, Apply and Analyse
CLO-2	Explain the clinical significance of the laboratory tests	PSO-3	Apply and understand
CLO-3	Diagnosis of clinical disorders by estimating biomarkers	PSO-3	Apply, Analyse and Evaluate
CLO-4	Determine various substances including substrates, enzymes, hormones, etc and their use in diagnosis and monitoring of disease are applied	PSO-3	Understand, Apply and evaluate
CLO-5	Evaluate the abnormalities which commonly occur in the clinical field	PSO-3	Understand and Analyse
CLO-6	Create awareness of different lifestyle diseases increasingly found in present day	PSO-3	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	Structure, properties and functions of carbohydrates, lipids and proteins: Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysaccharides. Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.	**7hrs**

1.2	Enzymes:Nomenclature, Characteristics (mention of Ribozymes), and Classification; Active site, Mechanism of enzyme action, Stereo specificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Bio catalysis: Importance in "Green Chemistry" and Chemical Industry. Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones Key words: Carbohydrates, qualitative, quantitativeLipids.	**9hrs**
Module-2		**16 hrs**
2.1	Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy. Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition. A diagnostic approach to biochemistry:	**8hrs**
2.2	Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anemia, regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin. Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine. Key words:Blood, Creatinine. Bilirubin.	**8hrs**

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Tool of Biochemistry	Cooper, T.G	Wiley-Blackwel	-	(1977)
2	Practical Biochemistry	Wilson, K. & Walker, J	Cambridge University Press	-	2009
3	Textbook of Biochemistry with Clinical Correlations	Devlin, T.M	John Wiley & Sons,	-	2010
RECOMMENDED BOOKS					
1	Practical Biochemistry	Wilson, K. & Walker, J	Cambridge University Press	-	2009
2	Textbook of Biochemistry with Clinical Correlations	Devlin, T.M	John Wiley & Sons,	-	2010

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Course Title	**MUSHROOM TECHNOLOGY (SC)**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	03	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	02Hrs	C3	70 Marks	

TEACHING METHOD:

Regular training is necessary for trainers to fully understand all tasks involved in mushroom

cultivation as to ensure that people with disabilities will be capable of accomplishing the required tasks and that they will not be subjected to needless failure and frustrations.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	To increase the production and consumption of mushrooms.
CO-2	To help create new employment opportunities for rural women and the youth through mushroom cultivation.
CO-3	To empower rural communities with entrepreneurial skills through the production and sale of mushrooms.
CO-4	To ensure adequate and satisfactory supply of spawn to rural communities involved in mushroom production.
CO-5	To exploit possibilities and assist in building up a mushroom industry that will make a significant contribution to the general economy.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Successful completion of the project with right technology and processes complying with all NHB Scheme requirements	PSO-2	Understand, Apply and Analyse
CLO-2	Reduced cost of production; improved crop health, productivity & Reduced losses	PSO-2	Apply and understand
CLO-3	Improved food safety, certification, standards compliance- at least process is initiated.	PSO-2	Apply, Analyse and Evaluate
CLO-4	Improved infrastructure	PSO-2	Understand, Apply and evaluate
CLO-5	Improved profits/ net income.	PSO-2	Understand and Analyse
CLO-6	Documentation of analysis of current scenario of trainees' context- production, harvest, post-harvest, supply chain, marketing and gap analysis and possible road map.	PSO-2	Analyse and understand

COURSE CONTENTS

Module-1		**16 hrs**
1.1	Introduction, History. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus.	**5hrs**
1.2	Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom Module (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparations of	**11hrs**

	spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparationLow cost technology, Composting technology in mushroom production. ***Key words: Edible mushrooms, Poisonous mushrooms, Cultivation technology***	
Module-2		**16 hrs**
2.1	Storage and nutrition: Short-term storage (Refrigeration – up to 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fiber content - Vitamins.	**8hrs**
2.2	Food Preparation: Types of foods prepared from mushroom. Research Centers - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value. ***Key words: Mushroom bed, Mushroom Module, Storage and Nutrition***	**8hrs**

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Oyster Mushrooms,	Marimuthu, T. Krishnamurthy, A.S. Sivaprakasam, K. and Jayarajan. R	Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore	-	1991
2	Food and Nutrition. Bappco	Swami Nathan M.	The Bangalore Printing and Publishing Co. Ltd	-	1990
3	Hand book of Mushrooms,	Nita Bahl	-	II Edition, Vol. I & Vol. II	1984-1988
RECOMMENDED BOOKS					
1	Food and Nutrition. Bappco	Swaminathan, M.	The Bangalore Printing and Publishing Co. Ltd	-	1990
2	Mushroom cultivation	Tewari, Pankaj and Kapoor, S.C	Mittal Publications, Delhi.	-	1988

OPEN ELECTIVE OFFERED BY THE DEPARTMENT

Course Title	**CHEMISTRY IN EVERYDAY LIFE**								
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02	
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100	
			External	Duration	03Hrs	C3	70 Marks		

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Classify the different types of drugs, understand the reactivity of analgesics and analyse the adverse reaction of drugs.
CO-2	Summarize the properties, behaviour and application of various metals
CO-3	Discuss the prevention and Control of Corrosion
CO-4	Classify and elaborates the preparation, properties and uses of natural and synthetic polymers.
CO-5	Identify the sources of Chemical poisons in food; classify the toxic minerals and metals in food and Food Standard.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Discuss the applications of antibiotics and analgesics	PSO-5	Understand and Apply
CLO-2	Describe the physical,chemical properties of metals and the applications of metals used in homes	PSO-3	Understand and Apply
CLO-3	Narrate the steps involved in prevention of corrosion in metals.	PSO-3	Understand and Analysis
CLO-4	Distinguish natural and synthetic rubber.	PSO-5	Remember, and Understand.
CLO-5	Identify the chemical poisons present in flavouring agents and food additives	PSO-3	Understand and Application
CLO-6	Gain knowledge to teach safety measures in daily life	PSO-5	Understand and Application

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	**Common drugs and medicines** Drug-classification, antibiotics - Applications of Penicillin, streptomycin, chloramphenicol, tetracyclins. Analgesics – Types, narcotic analgesic – morphine, apomorphine –Structure and uses.nonnarcotic analgesics – aspirin, paracetamol, analgin–Structure and uses. Burn Preparation- Chemical burn, Sun burn.Drugs in Combination, Prevention and Control of adverse reaction from drugs. **Metals in the service of man** Metals: properties – physical, mechanical, metal structure and properties. Corrosion of metalsatmospheric corrosion, electrochemical corrosion. Metals commonly used in homes- iron, copper, aluminium, nickel, tin, lead, titanium, zinc and their alloys. Metals for electronics - tungsten, selenium and germanium.Precious metals - silver, gold and platinum. Key words- Pharmaceutical Industrial Applications, Metals used in Industries	
Module – 2		**16 hrs**

2.1	**Corrosion prevention and care of metals** Prevention and control of corrosion- material selection, use of corrosion resistant alloys, use of protective coatings and linings, cathodic protection, elimination of corrosive agents. Care of household metals. Metal polishes – functions, composition and mode of action of polish, general rules for cleaning and polishes. Cleaning of aluminium metals, silverware, gold, copper and brasswares. Polymers - General properties and classification. Preparation, properties and uses of PVC, Teflon and polythene. Rubber - origin and chemical nature of natural rubber, vulcanized rubber and its properties. Synthetic rubbers - neoprene rubber, Styrene Butadiene rubber [SBR] and polyurethane – structure, properties and uses. **Chemical poisons in food** Sources of chemical poisons in food, toxic minerals and metals- fluoride, nitrate and selenium, natural organic toxicant in food- solanine, gossypol, oxalic acid and erucic acid, toxins in soyabean, spices , flavouring agents and fish, toxins in food from other sources, mercury, cadmium, tin and pesticide residues, food additives(polychlorinated biphenyls, N-nitroso compounds), contaminants of fats and oils. Food standards. ***Key words- Applications of metals in day today life, Prepare a chart of polymers*** used in our daily life, Methods of Detecting Food Poison	

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	A text book of applied chemistry	A Thankamma Jacob	McMillan India Ltd.	First	1979
2	Fundamental concept of applied chemistry	Jayashree Gosh	S. Chand Company	-	2006
RECOMMENDED BOOKS					
3	Industrial Chemistry	B.K. Sharma	Goel Publishing House Meerut		1995

Course Title	**WATER REMEDIATION AND CONSERVATION**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
CO-1	Communicate the importance of conserving water

CO-2	Measure the current scenario of drinking water quality
CO-3	Understand how much water industry uses
CO-4	Aware of the concept water remediation
CO-5	Elaborate about terraces for water erosion control

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Appreciate the importance of saving water - and act to conserve water	PSO-5	Understand and Apply
CLO-2	Summarize the impact of industrial and human contribution towards water pollution.	PSO-3	Apply, Analyse and Evaluate
CLO-3	Elaborate the factors affecting water erosion	PSO-5	Understand and Apply
CLO-4	Conduct case study of water-shed modeling for water conservation and water quality.	PSO-3	Understand, Apply, Analyse and Evaluate
CLO-5	Acquire the knowledge of mechanics of water erosion control	PSO-3	Understand and Analyse

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	Water remediation: Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality, chemistry of toxicants like arsenic, fluoride, chromium, lead and mercury, cause and effects of water pollution, remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, applications of non-toxic oxides and mixed oxides, regeneration and recycling, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope. Key words- Water pollutants, toxicants, remediation, detoxification and green	

Module – 2		**16 hrs**
2.1	Water conservation: Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control, agronomical measures of water erosion control, Terraces for water erosion control: Modeling of watershed processes, Case study of water-shed modeling for water conservation and water quality. Key words- Water conservation, mechanics of water erosion and case study of water-shed.	

100% Theory

REFERENCES

Sl. No	Title of the book	Name of the author	Name of the publisher	Edition	Year of publication
1	Water treatment: Principles and Design MWH publication.	Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G.	MWH publication	-	-
2	Environmental Chemistry	De A. K	Wiley Eastern	-	-
3	A text book of Environmental chemistry and pollution control,	Clarson D., Dara S. S.	S Chand Co.	-	-
RECOMMENDED BOOKS					
4	Soil and water analytical method	Clarson D., Dara S. S.	S Chand Co.		
5	Water Quality & Treatment: A Handbook on Drinking Water (Water Resources and Environmental Engineering Series)	Edzwald J.,	-	-	-

Course Title	**BIOFERTILIZERS (PRACTICAL BASED COURSE)**							
Course Type	Soft Core- Theory		Total Hours	32	Hours/Week	02	Credits	02
Course Code		Evaluation	Internal	C1+C2 = 15+15			30 Marks	100
			External	Duration	03Hrs	C3	70 Marks	

TEACHING METHOD: Lectures, Visual aids, Hands-on experience, chemical demonstrations, and group discussions.

COURSE OBJECTIVES:

CO No.	Course Objectives
	To introduce the concept microbes as biofertilizer.
CO-1	Understand the importance of rhizobium bacteria
CO-2	Gain the knowledge about a vital role of azobacter in every ecosystem
CO-3	Explain the role of cyanobacteria in the nitrogen cycle.
CO-4	Elaborate the concept green manuring and organic fertilizers
CO-5	Describe the procedure of vermicomposting.

MAPPING CLO'S WITH PSO'S AND CD'S

CLO No.	Course Learning Outcomes	PSOs Addressed	Cognitive Level
CLO-1	Apply the importance of Rhizobium bacteria for formers	PSO-5	Understand, Apply and Analyse
CLO-2	Understand the nitrogen fixation of azobacter and its role in agriculture.	PSO-5	Apply, Analyse and Evaluate
CLO-3	Knowledge about how Symbiosis can Established	PSO-5	Understand, Apply and Analyse

CLO-4	Analyse that organic production is more labour-intensive than conventional production	PSO-3	Understand, Apply Analyse and Evaluate
CLO-5	Adopt the traditional organic farming	PSO-3	Apply, Analyse and Evaluate
CLO-6	Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers	PSO-3	

COURSE CONTENTS

Module – 1		**16 hrs**
1.1	General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.	
1.2	Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.	
	Key words- Useful microbes, Rhizobium, Azospirillum, Azotobacter, Cyanobacteria, and Anabaena azollae.	

Module – 2		**16 hrs**
2.1	Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.	
2.2	Organic farming – Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.	
	Key words- Mycorrhiza, VAM, Organic farming, Recycling and vermicompost.	

100% Theory

REFERENCES

Sl. No	**Title of the book**	**Name of the author**	**Name of the publisher**	**Edition**	**Year of publication**
1	A Text book of Biotechnology	Dubey, R.C.	S.Chand & Co, New Delhi.	-	2005
2	Outlines of Plant Biotechnology	John Jothi Prakash, E.	Emkay Publication, New Delhi.	-	2004
3	Biotechnology	Kumaresan, V	Saras Publications, New Delhi.	-	2005
4	The complete Technology Book on Biofertilizer and organic farming.	NIIR Board	NIIR Project Consultancy Services.	2nd Edition.	2012
RECOMMENDED BOOKS					

1	Vermiculture and Organic Farming	Sathe, T.V.	Daya publishers.	-	2004
2	Biofertilizers in Agriculture and Forestry.	Subba Rao N.S.	Medtech.	Fourth Edition	2017
3	Bio-fertilizers and organic Farming Nadiad.	Vayas,S.C, Vayas, S. and Modi, H.A.	Akta Prakashan Nadiad.	-	1998

Q.P.Code:

St. Philomena's College (Autonomous), Mysore

I Semester –Course M.Sc Final Examination February-2021

Subject : Chemistry

Title: Fundamentals of Chemical Analysis (HC)

Time: 3 hrs **Max Marks: 70**

PART-A

1		**Answer any TEN of the following:**	**10x2=20**
	a		
	b		
	c		
	d		
	e		
	F		
	G		
	h		
	i		
	j		
	k		
	l		

PART-B

		Answer any Five of the following:	**5 x 10= 50**
2	a		
	b		
3	a		
	b		
4	a		
	b		
5	a		
	b		
6	a		
	b		
7	a		
	b		
8	a		
	b		
9	a		
	b		