PSGR Krishnammal College for Women

DEPARTMENT OF CHEMISTRY

CHOICE BASED CREDIT SYSTEM &

OUTCOME BASED EDUCATION SYLLABUS

MASTER OF CHEMISTRY

2022 - 2024

PROGRAMME OUTCOMES

After completion of the programme, the students will have the

PO1: ability to function as responsible individuals with ethical values, accountable to the community

PO2: detailed knowledge of the major areas of chemistry including a wide range of factual information and experimentally observed phenomena.

PO3: ability to apply chemical concepts in new situations i.e., ability to predict physical and chemical properties by comparison with analogues.

PO4: professional Skill to handle standard equipments and to analyze the data.

PO5: ability to solve unseen chemical problems both qualitative and quantitative by interpretation and manipulation of experimental data.

PO6: ability to present chemical research results to a technically literate audience by means of an oral presentation, scientific poster or a written report.

PO7: ability to assimilate in the course of different modules throughout the various years of study and to apply this when required.

PROGRAMME SPECIFIC OUTCOME

The students at the time of graduation will

PSO1: possess skills in spectral, analytical, qualitative and quantitative techniques which will be useful in industry

PSO2: be able to design a synthetic route for new compounds and transform innovative ideas into reality

PSO3: possess skill in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PSGR Krishnammal College for Women

DEPARTMENT OF CHEMISTRY

2022-2024

Sem	Subject Code	Title of the paper	Instruction hours/ week	Total Hours		Duration of Examination	Max. Marks			Credits
				Contact Hours	Tutorial Hours		CA	ESE	Total	
I	MCE2201	Paper – I Inorganic Chemistry and solid state chemistry	4	56	4	3	50	50	100	4
	MCE2202	Paper – II Organic Chemistry – I (Organic Reaction Mechanism & Stereochemistry)	5	71	4	3	50	50	100	5
	MCE2203	Paper – III Physical Chemistry – I (Classical & Statistical Thermodynamics)	5	71	4	3	50	50	100	5
	MCE2204	Paper – IV Analytical Techniques in Chemistry	4	56	4	3	50	50	100	4
	MCE21P1	Practical – I Organic Chemistry Practical - I	4	60	-	-	-	-	-	-
	MCE21P2	Practical – II Inorganic Chemistry Practical – I	4	60	-	-	-	-	-	-
	MCE21P3	Practical – III Physical Chemistry Practical – I	4	60	-	-	-	-	-	-
II	MCE2205	Paper V Organic Chemistry-II (Reagents, Rearrangements, Pericyclic Reactions& Photochemistry)	5	71	4	3	50	50	100	5
	MCE2206	Paper VI Physical Chemistry-II (Group Theory &Quantum Chemistry)	5	71	4	3	50	50	100	5
	MCE2207	Paper VII-Spectroscopy	4	56	4	3	50	50	100	4
	MCE21P1	Practical I Organic Chemistry Practical – I	4	60	-	6	50	50	100	4
	MCE21P2	Practical II Inorganic Chemistry Practical – I	4	60	-	6	50	50	100	4
	MCE21P3	Practical III Physical Chemistry Practical – I	4	60	-	6	50	50	100	4
	MCP19A1	IDC-Clinical microbiology &Biochemistry	4	60	-	3	-	100	100	4

QUESTION PAPER PATTERN

Continuous Internal Assessment :50 Marks

SECTION	MARKS	TOTAL
A – 4 X 2 Marks (No Choice)	08	50
B – 4 X 6 Marks (No Choice)	24	
C - 2 X 9 Marks (Internal Choice at same CLO Level)	18	

End Semester Examination: 100 Marks

SECTION	WORD LIMIT	MARKS	TOTAL
A- 5 x 2 Marks (No Choice)	One or Two Sentences	10	100
B -5 x 6 Marks (Either/or)	300	30	
C –5x 12Marks (Either/or)	600-800	60	

INTER-DISCIPLINARY COURSE (IDC) – 100 Marks

Bloom's Category	Section	Marks	Total
Understand (K_2)	A – 5X5 Marks (Either or)	25	100
Apply / Analyze, Evaluate (K_3, K_4, K_5)	B – 5 X15 Marks (Either or)	75	

CYBER SECURITY

Continuous Internal Assessment: 40 Marks

SECTION	MARKS	TOTAL
A – 5 / 8 X 2 Marks	10	40
B – 6 / 8 X 5 Marks	30	

WEIGHTAGE ASSIGNED TO VARIOUS COMPONENTS OFCONTINUOUS INTERNAL ASSESSMENT

Theory

	CIA I	CIA II	Model Exam	Assignment/Class Notes	Seminar	Quiz	Class Participation	Library Usage \ Application of Knowledge, Innovation & Creativity	Attendance	Max. Marks
Core	7	7	10	4	5	4	5	5	3	50
ALC		10	15	-	-	-	-	-	-	25
Information Security	40	40		10		10				100

Practical

Model Exam	Lab Performance	Regularity in Record Submission	Attendance	Maximum Marks
15	24	8	3	50

RUBRICS

Assignment/ Seminar

Maximum - 20 Marks (converted to 4 marks)

Criteria	**4 Marks**	**3 Marks**	**2 Marks**	**1 Mark**
Focus Purpose	Clear	Shows awareness	Shows little awareness	No awareness
Main idea	Clearly presentsa main idea.	Main idea supported throughout	Vague sense	No main idea
Organisation: Overall	Well planned	Good overall organization	There is a sense of organization	No sense of organization
Content	Exceptionally well presented	Well presented	Content is sound	Not good
Style: Details and Examples	Large amounts of specific examples and detailed description	Some use of examples and detailed descriptions	Little use of specific examples and details	No use of examples

CLASS PARTICIPATION

Maximum - 20 Marks (converted to 5 marks)

Criteria	5 Marks	4 Marks	3 Marks	2 Marks	1 Mark	Points scored
Level of Engagement in Class	Student proactively contributes to class by offering ideas and asks questions more than once per class.	Student proactively contributes to class by offering ideas and asks questions once per class	Student contributes to class and asks questions occasionally	Student rarely contributes to class by offering ideas and asking no questions	Student never contributes to class by offering ideas	
Listening Skills	Student listens when others talk, both in groups and in class. Student incorporates or builds off of the ideas of others.	Student listens when others talk, both in groups and in class.	Student listens when others talk in groups and in class occasionally	Student does not listen when others talk, both in groups and in class.	Student does not listen when others talk, both in groups and in class. Student often interrupts when others speak.	
Behavior	Student almost never displays disruptive behavior during class	Student rarely displays disruptive behavior during class	Student occasionally displays disruptive behavior during class	Student often displays disruptive behavior during class	Student almost always displays disruptive behavior during class	
Preparation	Student is almost always prepared for class with required class materials	Student is usually prepared for class with required class materials	Student is occasionally prepared for class with required class materials	Student is rarely prepared for class with required class materials	Student is almost never prepared for class.	
					Total	

COURSE	PROGRAMME OUTCOMES						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
COURSE - MCE2201							
CO1	H	H	H	M	M	H	H
CO2	H	H	H	M	M	H	H
CO3	H	H	H	M	M	H	H
CO4	H	H	H	M	H	H	H
CO5	H	H	H	H	H	H	H
COURSE – MCE2202							
CO1	H	H	H	M	M	H	H
CO2	H	H	H	M	L	H	H
CO3	H	H	H	M	L	H	H
CO4	H	H	H	M	L	H	H
CO5	H	H	H	M	M	H	H
COURSE – MCE2203							
CO1	H	H	H	M	H	H	H
CO2	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	H
CO4	H	H	M	M	M	H	H
CO5	H	H	H	M	H	H	H
COURSE - MCE2204							
CO1	H	H	H	H	H	H	H
CO2	H	H	H	M	H	H	H
CO3	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H
COURSE – MCE21P1							
CO1	H	H	H	H	H	H	H
CO2	H	H	H	L	H	H	H
CO3	H	H	H	L	H	H	H
CO4	H	H	H	H	H	H	H
COURSE - MCE21P2							
CO1	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H

CO4	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H
COURSE - MCE21P3							
CO1	H	H	H	H	M	M	M
CO2	H	H	H	H	H	H	H
CO3	H	H	H	M	M	M	M
CO4	H	H	H	M	H	H	H

SEMESTER-I & II

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE2201	INORGANIC CHEMISTRY PAPER – I (Inorganic Chemistry and Solid State Chemistry)	THEORY	56	4	-	4

Preamble

To make the students to

- gain knowledge about structure and bonding in inorganic chains and rings.
- understand the concepts of isopoly, heteropoly acids , anions and inorganic polymers.
- learn about inorganic crystals and structural determination methods.

Course Outcomes

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

CO Number	CO Statement	Knowldge Level
CO1	Identify and extend the applications of inorganic compounds as rings and clusters	K_2, K_3
CO2	Appraise the importance of inorganic polyacids	K_5
CO3	Extend and assess the applications of inorganic compounds as polymeric structures	K_2, K_5
CO4	Distinguish the types of solids and their defects	K_4
CO5	Determine and compile the structures of inorganic crystals	K_5, K_6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	M	M	H	H
CO2	H	H	H	M	M	H	H
CO3	H	H	H	M	M	H	H
CO4	H	H	H	M	H	H	H
CO5	H	H	H	H	H	H	H

H - High; M-Medium; L-Low

INORGANIC CHEMISTRY PAPER – I (MCE2201)

(Inorganic chemistry and solid state chemistry) **(56 Hrs)**

Unit – I **(12 Hrs)**

Chains and Rings

Chain – Catenation. Heterocatenation - Silicate minerals, orthosilicates, pyrosilicates, zeolites-intercalation compounds-preparation and properties.

Rings – Borazines, phosphozenes – Preparation, properties and structure.

Unit – II **(11 Hrs)**

Isopoly and Heteropoly Acids and Anions

Introduction, polymerization of CrO_4^{2-} anion, polymerization of molybdates, tungstates, vanadates, niobates and tantalates. Isopoly anions and isopoly acids of Mo^{6+} and W^{6+}, isopoly vanadates, isopoly niobates and isopoly tantalates. Heteropoly anions and heteropoly acids – different types, important reactions of iso and heteropoly anions.

Unit – III **(11 Hrs)**

Inorganic Polymers

Introduction, general properties, glass transition temperature, classification. Nitrides of sulphur - S_4N_4, $S_4N_3^+$, $(SN)_x$ – One dimensional conductors-preparation and structure. Silicon based polymers – Preparation, properties and types of silicones.

Unit – IV **(11 Hrs)**

Solid State Chemistry – I

Structure – Types and classification of solids, distinction between crystalline and amorphous solids. Unit cell, Bravais lattice, classification of crystals based on bond type and packing in crystals. Imperfections in crystals – Types of defects, stoichiometric defects – Schottky and Frenkel. Non-stoichiometric defects – Metal excess and metal deficient, consequences of metal deficiency defects.

Unit – V **(11 Hrs)**

Solid State Chemistry – II

Inorganic crystals – Coordination number, radius ratio rule and shapes of ionic crystals. Structures of ionic crystals – AX type: CsCl, ZnS (Zinc blende, Wurtzite), AX_2 type: CaF_2,

TiO_2, CdI_2. Experimental methods of crystal structure determination: X - ray diffraction, electron diffraction and neutron diffraction. Comparative study of the three diffraction methods.

Text Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	SatyaPrakash, G.D. Tuli, S.K. Basu, R.D. Madan	Advanced Inorganic Chemistry – Vol. I	S.Chand & Co. Ltd.	Reprint 2012
2	Gurdeep Raj	Advanced Inorganic Chemistry – Volume I	Krishna Prakasam Media (P) Ltd.	1999, 25th Edition
3	B.R. Puri, L.R. Sharma, K.C. Khalia	Principles of Inorganic Chemistry	Milestone Publisher	Copyright 2007-2008
4	James E. Huheey, Ellen A. Keiter	Inorganic Chemistry	Pearson	Copyright 2006, 4th Edition

Reference Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	F. Albert Cotton and Geoffrey Wilkinson	Advanced Inorganic Chemistry	Wiley Interscience	1999, 6th Edition
2	Anthony R. West	Solid State Chemistry and its Application	Wiley India	2011 Reprint
3	J.D. Lee	Concise Inorganic Chemistry	Wiley India	2010 Reprint

Pedagogy:

Lecture by chalk and talk, power point presentation, e-content, Simulation, group discussion, assignment, quiz, seminar.

Course Designers:

Dr. P. Kanchana

Dr. S. Jone Kirubavathy

Question Paper Pattern

End Semester Examination

SECTION	WORD LIMIT	MARKS	TOTAL
A- 5 x 2 Marks (No Choice)	One or Two Sentences	10	100
B -5 x 6 Marks (Either/or)	300	30	
C –5x 12Marks (Either/or)	600-800	60	

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE2202	PAPER II – ORGANIC CHEMISTRY – I (Organic Reaction Mechanism & Stereochemistry)	THEORY	71	4	-	5

Preamble

To enable the students to

- gain knowledge about the aromaticity and organic reaction mechanism
- understand the conformation & stereochemistry of organic compounds
- learn the mechanism of substitution & elimination reactions in aliphatic & aromatic compounds

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	analyze and predict the aromaticity of compounds	K4, K2
CO2	develop skills for identifying the kinetics of reactions	K5
CO3	predict and apply the mechanism for synthesizing organic compounds	K2, K3
CO4	analyze various elimination reactions and compare with substitution reactions	K4
CO5	employ the concepts of stereo isomerism to organic compounds	K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	M	M	H	H
CO2	H	H	H	M	L	H	H
CO3	H	H	H	M	L	H	H
CO4	H	H	H	M	L	H	H
CO5	H	H	H	M	M	H	H

H - High; M-Medium; L-Low

PAPER-II- ORGANIC CHEMISTRY – I(MCE2202)

(Organic Reaction Mechanism and Stereochemistry) (71 Hrs)

Unit I (14 Hrs)

Aromaticity

Criteria - Huckel's rule – Aromatic character in benzene, four, five, seven, eight membered rings- Aromaticity of benzenoids and heterocyclic compounds. Non benzenoid aromatics- azulene, ferrocene, tropolone, sydnones and annulenes (synthesis not required) - Non aromatic and anti-aromatic systems.

Reaction Mechanism

Types of reactions and mechanisms, Non kineticmethods- Product analysis, intermediate criteria (isolation, trapping and detection)- Isotopic labeling and cross over experiments- Stereochemical evidence. Kinetic methods- Mechanistic implications of rate law- Isotope effects. Kinetic and thermodynamic control of reactions - Hammonds postulates, linear free energy relationship- Hammett and Taft equations.

Unit II (14 Hrs)

Aliphatic Nucleophilic Substitution

The S_N1, S_N2 $S_N$imechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance.

Nucleophilic substitution at an allylic, aliphatic, trigonal and vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophiles and ambident substrates. Swain-Scott, Grunwald- Winstein relationship.

Aromatic Nucleophilic Substitution

The S_NAr, S_N1, Benzyne and SR_N1 Mechanisms. Reactivity – Effect of substrate structure, leaving group and attacking nucleophile.

O and S – nucleophiles, Bucherer and Rosenmund reactions, Von Richter rearrangement.

Unit III **(15 Hrs)**

Aliphatic Electrophilic Substitution

Bimolecular mechanisms – S_E2 (front), S_E2 (back) and S_Ei. Unimolecular mechanism- S_E1 mechanism, substitution by double bond shifts, other mechanisms – addition-elimination and cyclic mechanism.

Hydrogen electrophiles: hydro-dehydrogenation, keto-enol tautomerism.

Halogen electrophiles: Halogenation of aldehydes, ketones and carboxylic acids. Nitrogen electrophiles: aliphatic diazonium coupling. Sulphur electrophiles: sulphonation Carbon electrophiles: acylation, alkylation, Stork-enamine reaction.

Aromatic Electrophilic Substitution

Mechanism, orientation and reactivity, the ortho/para ratio. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling, ipso substitution. Sulphur electrophiles: Sulphonation, Jacobsen rearrangement. Carbon electrophiles: Alkylation, acylation, arylation reactions - Scholl reaction, Gattermann reaction, Gattermann-Koch reaction, Reimer- Tiemann reaction, Kolbe-Schmidt reaction, Houben- Hoesch reaction, Vilsmeier-Haack reaction, Hoffmann-Martius reactions.

Unit IV **(14 Hrs)**

Elimination Reactions

E1, E2 and E1cB mechanism, orientation of double bond- structural and stereochemical factors governing eliminations - Hoffmann and Saytzeff rules, Bredt's rule - Effect of changes in the substrate, base, leaving group and medium in E1, E2 and E1CB reactions- Elimination vs substitution- Pyrolytic elimination- Chugaev reaction- Hoffmann degradation- Cope elimination.

Unit V **(14 Hrs)**

Stereochemistry

Optical isomerism - Concept of chirality- Stereochemistry of sulphur and nitrogen compounds - Concept of prochirality - Enantiotopic and diastereotopic ligands and faces- Stereospecific and stereoselective reactions. R, S - nomenclature of compounds having one and more than one chiral centres- Axial chirality- (Optical isomerism of biphenyl, allenes and spirens)- Planar chirality (Optical isomerism of ansa compounds and cyclophanes)- Helicity (Optical isomerism of over- crowded molecules)

Geometrical Isomerism

E-Z Notation- Determination of configuration of geometrical isomerism- Stereoisomerism of cyclic compounds (upto six membered ring) - Aldoximes and ketoximes.

Conformational Analysis

Configuration and conformation- Conformation of acyclic compounds- cyclohexane, decalins, perhydrophenanthrenes and carbohydrates. Effect of conformation on reactivity, Curtin Hammett Principle.

Text Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	I.L. Finar	Organic Chemistry Vol I	Pearson Education	reprint 2009,6th Edition
2	I.L. Finar	Organic Chemistry Vol II	Pearson Education	reprint 2011,5th Edition
3	Jagdamba Singh and Yadav	Advanced Organic Chemistry	Pragati Prakasham	2010, 6th Edition
4	Jerry March	Advanced Organic Chemistry	Wiley Publications	reprint 2010,4th Edition.
5	Stanely H. Pine	Organic Chemistry	Tata MC Graw Hill	2007, 5th Edition
6	Jie Jack Li	Name Reactions	Springer	2004, 2nd Edition

Reference Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	R.K. Bansal	Organic Reaction Mechanism	Tata McGraw Hill Publications	reprint 2006, 3rd Edition
2	F. A.Carey and Sundberg	Advanced Organic Chemistry-Part A	Springer	2010
3	F. A.Carey and Sundberg	Advanced Organic Chemistry-Part B	Springer	2007
4	D .Nasipuri	Stereochemistry of Organic Compounds	New Age Publishers	2008, 2nd Edition

Pedagogy:

Lecture by chalk and talk, power point presentation, e-content, group discussion, assignment, quiz, seminar.

Course Designers:

1. Dr. G. Selvi
2. Mrs.N.Shyamala Devi
3. Dr. K. Kalaiselvi
4. Dr. P. Amutha

Question Paper Pattern
End Semester Examination

SECTION	WORD LIMIT	MARKS	TOTAL
A- 5 x 2 Marks (No Choice)	One or Two Sentences	10	100
B -5 x 6 Marks (Either/or)	300	30	
C –5x 12Marks (Either/or)	600-800	60	

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE2203	Paper-III-PHYSICAL CHEMISTRY PAPER – I (Classical & Statistical Thermodynamics)	THEORY	71	4	-	5

Preamble

To enable the students to

- understand and apply the concept of fugacity, activity and chemical potential.
- acquire knowledge on third law of thermodynamics and probability and ensembles.
- gain knowledge about the distribution laws (classical and statistical) and their applications

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	interpret the physical significance of chemical potential.	K2
CO2	apply and analyze probability to molecular energy levels.	K3 , K4
CO3	calculate the molecular velocities based on Maxwell Boltzmann distribution law.	K4
CO4	apply thermodynamic concepts to evaluate the relationship between thermodynamic properties.	K3, K6
CO5	evaluate statistical thermodynamics to the properties of identical indistinguishable particles like electrons	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	M	H	H	H
CO2	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	H
CO4	H	H	M	M	M	H	H
CO5	H	H	H	M	H	H	H

H - High; M-Medium; L-Low

PAPER III- PHYSICAL CHEMISTRY PAPER – I (MCE2203)

(Classical and Statistical Thermodynamics) (71 Hrs)

Unit I (14 Hrs)

Classical Thermodynamics

Concept of chemical potential – Fugacity- definition- determination of fugacity of gases by graphical method, from equation of state, approximation method and generalized method- variation of fugacity with temperature. Fugacity and the standard state for non-ideal gases- Fugacity coefficient, fugacity of mixture of non- ideal gases.

Activity and activity coefficient. Standard states – activity of solutions. Determination of activity of solute and solvent by freezing point method.

Unit II (14 Hrs)

Third Law of Thermodynamics

Nernst heat theorem, third law of thermodynamics - Need for third law, different forms of stating third law, thermodynamic quantities at absolute zero, probability and third law, statistical meaning of third law and apparent exceptions, negative absolute temperature.

Probability and Ensembles

Theorems of permutations, combinations and probability. Thermodynamic probability to molecular systems- States of maximum thermodynamic probability of systems involving energy levels.

Distinguishable and indistinguishable particles. Microstates and macrostates. Ensembles – definition- microcannonical, cannonical and grand cannonical ensembles.

Unit III (14 Hrs)

Maxwell Boltzmann Statistics

Stirling's approximation formula, Maxwell Boltzmann distribution law – assumptions, derivation for the system having non- degenerate and degenerate energy levels. Experimental verification of Maxwell's distribution of molecular velocities by Stern method. Limitations of Maxwell Boltzmann distribution law.

2D Velocity Distribution Law

Maxwell's distribution law of molecular velocities, evaluation of alpha and beta in Boltzmann statistics. Evaluation of average velocity, root mean square velocity and most probable velocity from distribution law of molecular velocities, molecular velocities and energies of an ideal gas.

Unit IV **(14 Hrs)**

Equipartition of Principle of Energy

Calculation of heat capacities of ideal gases- limitations.

Partition Functions

Definition- explanation- molecular partition function- molar partition function- Relationship between partition function and thermodynamic properties E, H, S, A, G, C_V and C_P. Translational partition functions- Sackur- Tetrode equation. Rotational partition functions – ortho/para hydrogen- vibrational partition functions- electronic partition functions. Evaluation of thermodynamic properties for mono and diatomic ideal gas molecules from partition functions.

Unit V **(15 Hrs)**

Quantum Statistics

Bose Einstein distribution law- derivation – entropy of boson applications. Derivation of Planck's black body radiation law. Bose Einstein condensation. Helium at low temperature Fermi – Dirac distribution law- derivation, entropy of fermions, Applications - electron gas, fermi energy of free electrons at absolute zero. Heat capacity of free electrons in metals. Heat capacity – Einstein theory and Debye theory, Debye T-cube law, comparison of Maxwell Boltzmann, Bose Einstein, Fermi - Dirac statistics

Text Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	Samuel Glassstone	Thermodynamics for Chemists	East West Press	Reprint 2002
2	M.C. Gupta	Statistical Thermodynamics	Wiley Eastern Publications	1990, 1st Edition
3	Ashley	Classical and Statistical Thermodynamics	Pearson Education	2012

Reference Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	P.W. Aktins	Physical Chemistry	Oxford University	1978, 1st Edition (Reprint 2005)
2	Gurdeep Raj	Advanced Physical Chemistry	GOEL Publishing House	2002, 27th Edition
3	Peter Atkins & Julio de Paula	Elements of Physical Chemistry	Oxford University	2nd Print 2014,5th Edition
4	F.W. Sears and G.L. Salinger	Thermodynamics, Kinetic & Statistical thermodynamics	Narosa Publishing House	Reprint 2013
5	Frederick.T. Wall	Chemical Thermodynamics	W.H. Freeman & Company	1974, 3rd Edition.

Pedagogy:

Lecture by chalk and talk, power point presentation, e-content, numerical exercises, group discussion, assignment, quiz, seminar.

Course Designers:

1. Dr. D.Nalini
2. Dr.N.Arunadevi
3. Dr. K. Kalaiselvi
4. Mrs. Sowmya Ramkumar

Question Paper Pattern
End Semester Examination

SECTION	WORD LIMIT	MARKS	TOTAL
A- 5 x 2 Marks (No Choice)	One or Two Sentences	10	100
B -5 x 6 Marks (Either/or)	300	30	
C –5x 12Marks (Either/or)	600-800	60	

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE2204	PAPER IV– ANALYTICAL TECHNIQUES IN CHEMISTRY	THEORY	56	4	-	4

Preamble

To enable the students to

- understand and analyze various types of chromatographic techniques.
- acquire knowledge about the configuration and confirmation of organic molecules by ORD and CD
- gain knowledge about the different thermal and electro analytical techniques.
- understand the principle of atomic absorption and Emission spectroscopy

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Apply HPLC, GC and SFC chromatographic techniques to identy the components	K1, K3
CO2	Relate the concepts of ORD & CD to predict the configuration and conformations of simple cyclic ketones	K3, K6
CO3	Classify thermo analytical techniques and to assess the thermal stability of a chemical compound	K2, K4, K6
CO4	Infer the principle, instrumentation of coulometry, polarography and cyclic voltammetry	K4
CO5	Perceive the sources, properties, types of atomizers and their applications	K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	H	H	H	H
CO2	H	H	H	M	H	H	H
CO3	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H

CO5	H	H	H	H	H	H	H

H - High; M-Medium; L-Low

PAPER IV– ANALYTICAL TECHNIQUES IN CHEMISTRY (MCE2204) (56 Hrs)

Unit I **(11 Hrs)**

Chromatography

High Pressure Liquid Chromatography (HPLC)-Introduction, Characteristic features of HPLC, Principle, column processes & band broadening, instrumentation, Applications of HPLC.

Gas Chromatography (GC) - Introduction, Principle, Theory, instrumentation, Evaluation of gas chromatogram, identification of chromatogram, plate theory for GC, Applications.

Super Critical Fluid Chromatography (SFC) - Characteristics of super critical fluids, Comparison of SFC with HPLC & GLC, Applications of SFC

Unit II **(11 Hrs)**

Analytical Techniques

ORD & CD – Principle, instrumentation - Visual Polarimetry (for ORD) types of ORD curves, axial haloketone rule & octant rule – Applications to determine the configuration & conformation of simple monocyclic & bicyclic ketones.

Unit III **(11 Hrs)**

Thermoanalytical Methods

Principle - Thermogravimetric analysis & differential thermal analysis- discussion of various components with block diagram- TGA & DTA curves of $CuSO_4.5H_2O$, $MgC_2O_4.H_2O$ & $Ca(OOCCH_3)_2.H_2O$ – Simultaneous DTA-TGA curves of $SrCO_3$ in air & $CaC_2O_4.H_2O$ in air & CO_2. Factors affecting TGA & DTA curves. UPS & ESCA- Basic principles, sources, instrumentation, applications. DSC- Principle, Instrumentation and application.

Unit – IV **(12 Hrs)**

Electro Analytical Techniques

Coulometry: Introduction, Types of colometric methods, Types of coulometers – O_2-H_2, Ag & I_2 coulometer, coulometric titrations- Internal and external generation of titrants, applications.

Polarography: Introduction, apparatus, working, polarographic measurements, interpretation of polarographic waves, equation for polarographic wave, half wave potential, DME - Applications.

Cyclic Voltammetry: Principle, Normal Pulse Voltammetry (NPV), Differential Pulse Voltammetry (DPV)

Unit – V **(11 Hrs)**

Atomic Spectroscopy

Sources of atomic and emission absorption spectra. Atomic spectroscopy based on flame atomization – flame atomizers, properties of flames, quantitative analysis. Flame Atomic Absorption Spectroscopy – Introduction, sources, instrumentation. Flame emission spectroscopy – Introduction, instrumentation.

Text Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1.	E.L Eliel	Stereochemistry of Carbon Compounds	Tata Mc Graw Hill	2004, 30th Edition
2.	Dr. H. Kaur	Instrumental Methods of Chemical Analysis	Pragati Prakashan	2008, 4th Edition
3.	Mahinder Singh	Analytical Chemistry- Instrumental Techniques	Dominant Publishers & Distributors NewDelhi	2003, 1st Edition
4.	B. K Sharma	Instrumental Methods of Chemical Analysis	Goel Publications	1996, 15th Edition
5.	H. H Willard, L. L Merritt. and J. A Dean, F.A. Settle	Instrumental Methods of Analysis	CBS Publishers & Distributors	1986, 7th Edition

Reference Books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1.	L.I.Antropov	Theoretical electrochemistry	MIR publishers, Moscow	1972, 1st Edition
2.	S. M. Khopkar	Basic Concepts of Analytical Chemistry	Wiley Eastern Ltd	1884, First Edition
3.	D. A Skoog, F.J.Holler and D. M West	Analytical Chemistry- An Introduction	Saunders College Publications	1994, 6th Edition
4.	M.S.Yadav	Instrumental Methods of Chemical Analysis	Campus Book	2006, 1St Edition

Pedagogy: Lecture by chalk and talk, power point presentation, e-content, Simulation, numerical exercises, group discussion, assignment, quiz, seminar.

Course Designers:

1. Ms. E. Kayalvizhy
2. Mrs. G. Sathya Priyadarshini

Question Paper Pattern

End Semester Examination

SECTION	WORD LIMIT	MARKS	TOTAL
A- 5 x 2 Marks (No Choice)	One or Two Sentences	10	100
B -5 x 6 Marks (Either/or)	300	30	
C –5x 12Marks (Either/or)	600-800	60	

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE21P1	PRACTICAL I - ORGANIC CHEMISTRY PRACTICAL – I	PRACTICAL	-	-	120	4

Preamble

To enable the students to

- separate two components in an organic mixture
- identify the separated components by qualitative tests
- determine the boiling point / melting point of components
- prepare organic compounds

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

CO Number	CO Statement	Knowledge Level
CO1	separate organic mixtures by solvent extraction	K4
CO2	analyze organic compounds	K4
CO3	develop skills in the synthesis of organic compounds	K5
CO4	determine boiling point /melting point	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	H	H	H	H
CO2	H	H	H	L	H	H	H
CO3	H	H	H	L	H	H	H
CO4	H	H	H	H	H	H	H

H - High; M-Medium; L-Low

PRACTICAL I - ORGANIC CHEMISTRY PRACTICAL – I (MCE21P1) (120 Hrs)

1.Qualitative Analysis:

Analysis of two component mixtures – Separation, identification of components and determination of melting point/ boiling point of the components.

2. One stage preparations and purification by recrystallization technique

(i) m-dinitrobenzene from Nitrobenzene
(ii) Resacetophenone from Resorcinol
(iii) Tribromoaniline from Aniline
(iv) Diazoaminobenzene from Aniline
(v) Anthranilic acid from Pthalimide
(vi) Methyl orange from sulphanilic acid

3. Characterization of any two of the above compounds by IR spectra

Note: A minimum of five organic mixtures should be done by each student.

Text Book: LAB MANUAL - Prepared by Faculty, Department of Chemistry, PSGR Krishnammal College for Women

Reference books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	Arthur I. Vogel	Elementary Practical Organic Chemistry (part 2)Qualitative Organic Analysis	Pearson Education	2011, 2nd Edition.
2	F.G. Mann & B.C. Saunders	Practical Organic Chemistry	Pearson Education	2009, 4th Edition

Pedagogy: Demonstration and hands on practicals

Course Designers:

1. Dr.S.Chitra
2. Mrs.E.Kayalvizhy
3. Mrs.G.Sathya Priyadarshini

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE21P2	PRACTICAL II – INORGANIC CHEMISTRY PRACTICAL-I	PRACTICAL	-	-	120	4

Preamble

To enable the students to

- separate the common and rare cations in a mixture
- characterize two common and two less familiar cations
- estimate quantitatively magnesium, nickel and zinc by complexometry
- prepare inorganic complexes

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	separate common and rare cations	K3
CO2	analyse and report cations in a mixture	K4
CO3	estimate the metal ions in complexes	K5
CO4	develop skills in the synthesis of inorganic complexes	K5, K6
CO5	Interpret IR spectra of metal complexes	K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H

H - High; M-Medium; L-Low

PRACTICAL II - INORGANIC CHEMISTRY PRACTICAL – I (MCE21P2) (120 Hrs)

1.Qualitative Analysis

Qualitative Analysis employing semi micro methods & spot tests of mixtures of common cations & ions of the following less familiar elements - Molybdenum , Thallium, Tungsten, Selenium, Tellurium, Cerium, Thorium, Titanium, Zirconium, Vanadium, Beryllium, Uranium & Lithium.

2. **Titrimetry**

Complexometric titrations using EDTA - Estimations of Magnesium, Nickel & Zinc.

3. Preparation of Inorganic Complexes

i. Tris(thiourea)copper (I)chloride
ii. Potassium tris(oxalato)ferrate(III)
iii. Hexammine cobalt(III)chloride
iv. Ammonium hexachlorostannate(IV)
v. Tetramminecopper(II)sulphate

4. Characterization of any two of the above complexes by IR spectra

Text Books:LAB MANUAL - Prepared by Faculty, Department of Chemistry, PSGRKrishnammal College for Women

Reference books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	Arthur I.Vogel	Macro & Semimicro Qualitative Inorganic Analysis	Orient Long man's Ltd	1968, 1st Edition
2	G.Palmer	Experimental Inorganic Chemistry	Cambridge University Press	1964, 3rd Edition.

Pedagogy: Demonstration and hands on practicals

Course Contents and Lecture Schedule

Course Designers:

1. Mrs. P. Kanchana
2. Mrs.V. Hemapriya

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCE21P3	PRACTICAL III - PHYSICAL CHEMISTRY PRACTICAL - I	PRACTICAL	-	-	120	4

Preamble

To make the students to

- understand the principle and to carry out the potentiometric titrations.
- determine the pH and pKa values of buffers and acids
- determine the molecular weight of solutes.
- construct the Phase diagram of two components systems.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	set up a pH electrode to prepare for a potentiometric titration	K_6
CO2	examine the strength of the solutions and Ka values by potentiometry	K_4
CO3	calculate the molecular weight of chemical compounds from K_f values by Rast micro method	K_4
CO4	construct and analyze Phase diagrams	K_5, K_6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	H	H	H	M	M	M
CO2	H	H	H	H	H	H	H
CO3	H	H	H	M	M	M	M
CO4	H	H	H	M	H	H	H

H - High; M-Medium; L-Low

PRACTICAL III - PHYSICAL CHEMISTRY PRACTICAL – I (MCE21P3)(120Hrs)

1. Molecular weight determination by Rast Micro Method
2. Phase study: Simple Eutectic System & Compound Formation
3. Phase Study: System with Compound Formation
4. Determination of Transition Temperature of Salt Hydrate
5. Viscosity: Variation of viscosity of liquids with temperature
6. Electromotive Force:
   (i) Determination of Standard Potentials (Cu, Zn, Ag)
   (ii) Evaluation of Thermodynamic Quantities from EMF Data (Daniel Cell)
   (iii)Determination of pH & pKa values using Hydrogen & Quinhydrone electrodes
7. Potentiometric Titrations:
   i. Titration of HCl vs NaOH
   ii. Titration of mixture of acids against a strong base
   iii. Titration of CH_3COOH vs NaOH
   iv. Redox titrations:
      (a) Titration of Ferrous ammonium sulphate against Potassium dichromate
      (b) Titration of Potassium iodide against Potassium permanganate
   v. Determination of solubility product of a sparingly soluble salt (Concentration Cell & Chemical Cell)
   vi. Precipitation titrations:
      (a) Estimation of KI by titration with $AgNO_3$ using KCl as standard
(b) Titration of mixture of halides against $AgNO_3$ solution

Text Books:
LAB MANUAL-Prepared by Faculty, Department of Chemistry, PSGR Krishnammal College for Women

Reference books:

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	B.P. Levitt	Findlay's Practical Physical Chemistry	Longman Publications	1973, 9th Edition
2	G.Palmer	Experimental Physical Chemistry	Cambridge University Press	1964, 1st Edition
3	B. Viswanathan & P.S. Raghavan	Practical Physical Chemistry	Viva Books	2009,3rd Edition

Pedagogy: Demonstration and hands on practicals

Course Designers

1. Dr.S.Chitra
2. Mrs.E.Kayalvizhi
3. Mrs.G.Sathyapriyadarshini