

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE
(AUTONOMOUS)**

**KAKINADA - 533 001,
EAST GODAVARI, A.P.**

Affiliated to Adikavi Nannaya University

NAAC Accredited with "A" Grade (3.17 CGPA)

BOARD OF STUDIES OF CHEMISTRY

M. Sc CHEMISTRY Under CBCS



Convened on 18 December 2023

AY 2023-24

DEPARTMENT OF CHEMISTRY

P. R. GOVT. COLLEGE (Autonomous)

**Opp. Mc Laurin High School, Raja Ram Mohan Roy Road,
Kakinada**

www.prgc.edu.in

e-mail: chemistry@prgc.edu.in

**PROCEEDINGS OF THE PRINCIPAL,
PITHAPUR RAJAHS GOVERNMENT COLLEGE(A),
KAKINADA-A. P**

Present: Dr. B. V. Tirupanyam, M.Sc.; Ph.D.

R.C.No.12A/A.C./BOS/2023-24, Dated: _____.

SUB: P.R. Government College(A), Kakinada-PG Board of Studies (BOS)-
Program/Course-M.Sc., /Chemistry, Nomination of Members-Orders issued.

REF: 1. UGC Guidelines for Autonomous Colleges-2018.

ORDERS:

The Principal, Pithapur Rajahs Government College(A), Kakinada is pleased to constitute P G Boards of Studies in Chemistry for framing the syllabi in Chemistry Subject for I, II Semesters duly following the norms of the UGC Autonomous guidelines.

S. No	Name of the Nominee	Designation
1	V. Sanjeeva Kumar	Chairman& Lecturer Incharge.
2	Dr. K. Deepthi	University Nominee Associate Professor Department of Chemistry Adikavi Nannaya University, Rajamahendravaram
3	Dr. A. Chandra Leela	Subject Expert Associate Professor Andhra University Visakhapatnam
4	Dr. G. Chandrasekhar Reddy Managing Director HIQ Pharma Pvt. Ltd Hyderabad	Representative from Industry
5	T.V.V. Satya Narayana	Member
6	P. Vijay Kumar	Member
7	V. Rambabu	Member
8	G. Pavani	Member
9	Dr. N. Bujji Babu	Member
10	Dr. Ch. Praveen	Member
11	V. Venkateswara Rao	Member
12	U.S.N. Prasad	Member
13	T. Pavan Kumar	Member
14	S. Abhisha	Member
15	S. Sirisha	Member
16	R. Ramya Sri	Member
17		Student Alumni Member
18		Student Member
19		Student Member

The above members are requested to attend the BoS meeting on 18 Dec. 23 and share their valuable reviews, and suggestions on the following functionaries.

- Prepare syllabi for the subject keeping in view the objectives of the college, interest of the stake holders and National requirement for consideration and approval of the IQAC and Academic Council.
- Suggested methodologies for innovative teaching and evaluation techniques.
- Suggest the panel of Names to the academic council for appointment of Examiners.
- Coordinate research, teaching, extension, and other activities in the Department of the college.



PRINCIPAL

PRINCIPAL

KAKINADA

P. R. Government College(A),
Kakinada

**PITHAPUR RAJAH'S GOVERNMENT COLLEGE (A),
KAKINADA
DEPARTMENT OF CHEMISTRY
MINUTES OF BOARD OF STUDIES (BOS) MEETING**

2023-24 on 18 December 2023 Meeting of Board of Studies in M. Sc Chemistry is convened on 18 Dec. 23 through offline at Pithapur Rajah's Government College (A), Kakinada.

Venue: LCD Hall-I, Dt: 18 December 2023.

The Principal Dr. B.V. Tirupanyam, Chairman, Sri. V. Sanjeeva Kumar, Chairman and lecturer in charge, University Nominee, Dr. K. Deepthi, Industrialist, Dr. G. Chandrasekhar Reddy, Subject Expert, Dr. D. Chenna Rao, Subject Expert, Dr. P. Shyamala, All the faculty members of Chemistry Department and student alumni attended the meeting.

Agenda:

1. To discuss the Semester System and revised Choice Based Credit System (CBCS) being implemented for the past 03 years, i.e., w.e.f. 2020-21.
2. To discuss and approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I & II for 2023-24.
3. Grant of Extra credits for Online SWAYAM MOOCs etc.
4. Syllabus, Model Question Papers and Model Blueprints, POs, PSOs & COs mapping for I and V Semesters.
5. Minimum of 60% integration of ICT into transaction of curriculum.
6. Minimum attendance of 75% for both I mid-term examination, and II mid-term examination under CIA component shall be the benchmark for attendance and it shall be approved in the BOS.
7. Teaching learning methodology by 75:25 (External: Internal) ratio w.e.f. 2017-18 admitted batches and continued it.
8. Remedial coaching for slow learners and project work, research, Conferences, etc., for advanced learners.
9. Panel of paper setters and examiners.
10. Proposals for project work in fourth semester for the benefit of students.
11. Department action plan for 2023-24. To discuss and resolve the minor modifications/refinement if any.
12. Any Other Proposal with the Permission of the Chairman.

The following paper setters are recommended.

1. Dr. V. Siddaiah, Department of Chemistry, Andhra University, Visakhapatnam
2. Dr. D. Jaya Prashanthi Department of Chemistry, Andhra University, Visakhapatnam
3. Dr. B. Mallikarjun, Department of Chemistry, GDC(A), Rajamahendravaram.
4. Dr. K. Deepthi, Department of Chemistry, ANUR Rajamahendravaram
5. Dr. B. Jagan Mohan Reddy, Department of Chemistry, ANUR Rajamahendravaram
6. Dr. Ravindra Babu, Department of Chemistry, GDC, Tanuku
7. Dr. A. Chandraleela, Department of Chemistry, Andhra University, Visakhapatnam

Resolution:

It is resolved to introduce the following new courses in the programme M.Sc Chemistry from the AY 2023-24

S. No	Course Code	Title of the new course	Programmes in which it is introduced
1		Nil	Nil

ADDITIONS/DELETIONS IN COURSES CHEMISTRY 2023-24

Year	Semester & Paper	Additions	Deletions
I	I&I	Schrodinger's cat paradox (qualitative analysis only)	solution of wave equation- selection rules
I	I&II	Walsh diagram for H ₂ S molecule	-
I	I&III	Electromeric effect Pseudo Aromaticity	
I	I&IV	Trounton's law	-
I	II&I	-	-
I	II&II	Na ⁺ , Mg ⁺² , Co ⁺³ Zn ⁺²	Biological and a biological Nitrogen Fixation
I	II&III	E1cB mechanism	--
I	II&IV	-	-

Course structure of M. Sc Chemistry (Previous)

S. No	Semester	Title of the Paper	Theory/ Practical / Viva	Internal marks	External Marks	Total Marks	Credits
1	I	General Chemistry- I	T	25	75	100	4
2		Inorganic Chemistry-I	T	25	75	100	4
3		Organic Chemistry- I	T	25	75	100	4
4		Physical Chemistry- I	T	25	75	100	4
5		Inorganic Chemistry Practical- I	P	25	75	100	4
6		Organic Chemistry Practical -I	P	25	75	100	4
7		Physical Chemistry Practical -I	P	25	75	100	4
8		II	General Chemistry	T	25	75	100
9	Inorganic Chemistry		T	25	75	100	4
10	Organic Chemistry		T	25	75	100	4
11	Physical Chemistry		T	25	75	100	4
12	Inorganic Chemistry Practical- II		P	25	75	100	4
13	Organic Chemistry Practical -II		P	25	75	100	4
14	Physical Chemistry Practical -II		P	25	75	100	4
Total Credits							

	PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA DEPARTMENT OF CHEMISTRY	Program & Semester			
Course Code	TITLE OF THE COURSE GENERAL CHEMISTRY - I	I M.Sc. (I Semester)			
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites	Operators, wave mechanics	60	10	---	4

Course Objectives:

1. Quantum chemistry
2. Fundamentals of molecular spectroscopy

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Derivation of wave equation and energy for various systems
CO2	Quantization of energy for rotating and oscillating bodies and in various dimensional Boxes
CO3	IR spectral studies of various oscillating bodies and micro wave spectral studies of various rotating bodies
CO4	Basic theory of NMR spectroscopy, instrumentation with applications

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus:

UNIT-I

Basic Quantum Chemistry-I:

(A) Wave equation-interpretation of wave function-properties of wave function-normalization

And orthogonalization, Operators- linear and non-linear- commutators of operators. **Postulates of quantum mechanics; setting up of operators to observables;**

(B) Hermitian operator- Eigen values and Eigen functions of Hermitian operator; Expansion theorems. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

(C) Hermitian operator- Eigen values and Eigen functions of Hermitian operator; Expansion theorems.

Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

UNIT-II

Basic Quantum Chemistry-II:

(A) Wave mechanics of simple systems with constant potential energy, particle in one dimensional box-factors influencing color transition- dipole integral, Symmetry arguments in deriving the selection rules, the concept of tunneling. Schrodinger's cat paradox(qualitative analysis only)

(B) Particle in three -dimensional box. Calculations using wave functions of the particle in a box- Orthogonality, measurability of energy, position and momentum, average values and probabilities. Rigid rotor, Wave mechanics of systems with variable potential energy-simple harmonic oscillator- hydrogen atom, including shapes of atomic orbitals

UNIT-III

Fundamentals of Molecular Spectroscopy-I:

(A) Microwave and IR- Spectroscopy- Rotational spectra of diatomic molecules-Rigid Rotor-Selection rules- Calculations of bond length- Isotopic effect, Second order stark effect and its applications.

(B) Infrared spectra of diatomic molecules- harmonic and anharmonic oscillators- Selection rules- Overtones- Combination bands- Calculation of force constant, anharmonicity constant and zero-point energy. Fermi resonance, simultaneous vibrational-rotational spectra of diatomic molecules.

UNIT- IV

Fundamentals of Molecular Spectroscopy-II:

(A) Raman and Electronic Spectra- Classical and quantum mechanical explanations- Rotational Raman and Vibrational Raman spectra.

(B) Electronic spectra of diatomic molecules- Vibrational Coarse structure- intensities of spectral lines- Franck-Condon principle- applications, Rotational Fine structure- band head and band shading. Charge transfer spectra

Unit no	Additions	Deletions	Expected levels of learning as per Blooms Taxonomy for assessment of CO	Percentage added/added
2	Schrodinger's cat paradox (qualitative analysis only)	solution of wave equation- selection rules	K ₃	2%

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analyzing, K₅= Evaluating, K₆= Create

Text books:

S. No	AUTHOR	TITLE	PUBLISHER
1	A.K. Chandra	Introductory quantum mechanics	Tata McGraw Hill
2	R.K. Prasad	Quantum chemistry	New Age International Publications
3	C.N. Banwell	Fundamentals of molecular spectroscopy	McGraw Hill

Reference books

S. No	AUTHOR	TITLE	PUBLISHER
1	R.S. Drago	Physical Methods for Chemists	Affiliated East West Press Pvt. Ltd.
2	B.K. Sharma	Molecular Spectroscopy	Oxford University Press
3	Aruldas	Molecular Spectroscopy	Oxford University Press

Web Links:

1. <https://youtu.be/8zDhIf50HIc?si=Bk2XhT1x8fzudcpQ>
2. <https://youtu.be/g2sqX3FkcRo>
3. <https://youtu.be/e4VHMSO5eqM>
4. <https://youtu.be/5VZm7IsT1xM>

Course Outcome & Program outcome mapping

On Completion of the course, the students will be able to	
CO1	Derivation of wave equation and energy for various systems
CO2	Quantization of energy for rotating and oscillating bodies and in various dimensional boxes
CO3	IR spectral studies of various oscillating bodies and micro wave spectral studies of various rotating bodies
CO4	Basic theory of NMR spectroscopy, instrumentation with applications

CO-PO Mapping:

1: Low=1; 2: Moderate=2; 3: High=3; 4: No Correlation=0

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
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CO1	3	1	3	3	3	1	1	1	2	2	3	3	1
CO2	3	1	3	3	3	1	1	1	2	2	3	3	1
CO3	3	2	3	3	2	1	1	1	1	2	3	2	1
CO4	3	2	3	3	2	1	1	1	1	2	3	2	1

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Quantum chemistry to the solution of simple to complex synthesis of organic molecules.

(PO2) Critical Thinking: Carry out experiments in the area of Molecular Spectroscopy for Structural analysis inorganic and Organic Compounds and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of Molecular Spectroscopy and Quantum Chemistry.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modeling and analyze the data obtained from sophisticated instruments for chemical analysis.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Quantum Chemistry.

PSO2 - Demonstrate the knowledge of Quantum Chemistry and Molecular Spectroscopy in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Molecular Spectroscopy data analysis, scientific interpretation, and reaction mechanisms with an understanding on basic tools to be employed.

Weightage to content

Semester -I

Paper-I

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	Basic Quantum Chemistry-I	2	2	36	Understanding, Application
2	Basic Quantum Chemistry-II	2	2	36	Remembering, Understanding
3	Fundamentals of Molecular Spectroscopy-I	2	2	36	Application & Creation
4	Fundamentals of Molecular Spectroscopy-II	2	2	36	Remembering, Understanding
	TOTAL	8	8	144	

(General chemistry)

Paper- I
MODEL PAPER

Duration: 3hrs

Max. Marks: 75M

PART- A

Answer all questions

(4 × 15 = 60M)

1. (a) Write note on postulates of quantum mechanics.

(OR)

(b) Setting the operators for various physical quantities.

2. (a) Derive wave equation for Rigid Rotor.

(OR)

(b) Derive wave function for one dimensional harmonic oscillator.

3. (a) Explain the rotational spectra of rigid diatomic molecule and also explain the effect of isotope.

(OR)

(b) Write a brief note on simultaneous rotational and vibrational spectra of diatomic molecule.

4. (a) i) Write a note on pure Raman rotational spectra.

ii) Classical theory of Raman effect.

(OR)

(b) i) Write a note on charge transfer spectra.

ii) Write a note on vibrational coarse structure.

PART-B

Answer any Five questions

(5 × 3 = 15M)

5. Write a note on Normalization.

6. Write about interpretations of wave function.

7. Write a note on factors affecting colour.

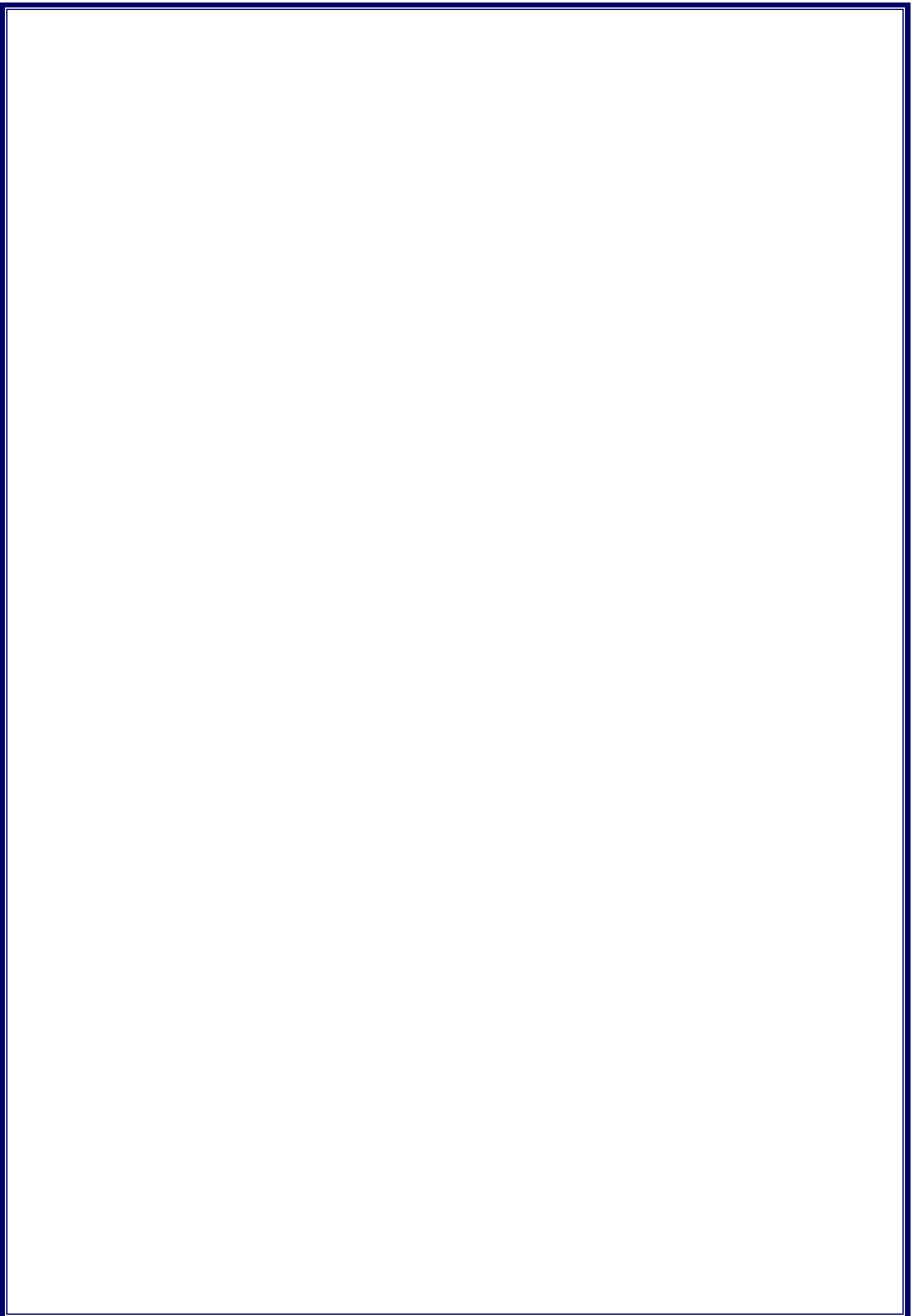
8. Derive wave functions for particle in one dimensional box.

9. Write about anharmonic oscillator.

10. Write about rotational spectra of non-rigid rotor.

11. Write a note on Quantum theory of Raman effect.

12. Write about Rotational fine structure



	PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA DEPARTMENT OF CHEMISTRY	Program & Semester			
Course Code	TITLE OF THE COURSE INORGANIC CHEMISTRY-I	I M Sc (I Semester)			
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites	Electronic configurations, calculation of oxidation states, trends in periodic table, shape of the orbitals, theories in bonding	60	10	30	4+3

Course Objectives:

1. Structure & Bonding
2. Inorganic cage and ring compounds
3. Coordination compounds
4. Electronic spectra of transition metal complexes

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Understand the theories of bonding in compounds and applications
CO2	Preparation, structure, classification and reactivity of boranes and also nano technology
CO3	Theories of coordination compounds and its applications
CO4	Gain knowledge on Selection rules and Electronic spectra of transition metal complexes

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus:

UNIT-1

Structure & Bonding:

(A) **Applications of VSEPR**, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules- role of p and d orbitals in π -bonding.

(B) **Application of MO theory to Tetrahedral $[\text{CoCl}_4]^{2-}$, Square planar $[\text{PtCl}_4]^{2-}$ and Octahedral complexes $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$** . Classification of ligands based on π -bonding using MO theory. Walsh diagram for H_2O and H_2S molecule.

UNIT-II

Inorganic cage and ring compounds:

(A) Preparation, structure and reactions of boranes, carboranes, metallo carboranes. **Electron counting in boranes - Wades rules (Polyhedral skeletal electron pair theory)**. Heterocyclic inorganic ring systems: Boron-Nitrogen ($H_3B_3N_3H_3$). Phosphorus-Nitrogen ($N_3P_3Cl_6$) and Sulphur-Nitrogen (S_4N_4 , $(SN)_x$) cyclic compounds. Cage Compounds: Phosphorous oxides and Phosphorous sulphides. Isopoly and heteropoly anions.

B. **Nano materials, Synthetic techniques, properties and applications of Nano materials.**

UNIT-III

Coordination compounds:

(A) Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. **Calculation of crystal field stabilization energies**. Factors effecting crystal field splitting energies - Spectrochemical series.

(B) Jahn - Teller effect, nephelauxetic effect - ligand field theory. Term symbols - Russell-Sanders coupling - derivation of **term symbols** for various configurations. Spectroscopic ground states.

UNIT- IV

Electronic spectra of transition metal complexes:

(A) **Types of electronic transitions - d-d transitions - Selection rules**, breakdown of selection rules - Orgel and Tanabe-Sugano diagrams for d1 -d9 octahedral and tetrahedral transition metal complexes of 3d series - Calculation of Dq , B and β parameters.

(B) **Charge transfer spectra**. **Magnetic properties of transition** and inner transition metal complexes - spin and orbital moments - quenching of orbital momentum by crystal fields in complexes.

Unit no	Additions	Deletions	Expected levels of learning as per Blooms Taxonomy for assessment of CO	Percentage added/added
1	Walsh diagram for H_2S molecule	-	K_4	2%
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-

K_1 = Remembering, K_2 = Understanding, K_3 = Applying, K_4 = Analyzing, K_5 = Evaluating, K_6 = Create

Reference books

S. No	AUTHOR	TITLE	PUBLISHER
1	F.A. Cotton	Advanced Inorganic chemistry IV Edition	John Wiley and Sons
2	J.E. Huheey	Inorganic chemistry III Edition	Harper International Edition
3	Mc. Day and J. Selbin	Theoretical inorganic chemistry II Edition	Affiliated East west press
4	Shriver Atkins	Inorganic chemistry	Oxford University Press
5	Garry L.Meissler	Inorganic chemistry, V Edition	Pearson Publications

Web Links:

- <https://youtu.be/JxjUGCp9aUs>
- https://youtu.be/-MH_uwkxyAA
- https://youtu.be/akDgsFPf4Ho?si=Z4eX1qVV_98DI094

Course Outcome & Program outcome mapping

On Completion of the course, the students will be able to	
CO1	Theories of bonding in compounds and applications
CO2	Preparation, structure, classification and reactivity of boranes and also nano technology
CO3	Theories of coordination compounds and its applications
CO4	Electronic spectra of transition metal complexes

CO-PO Mapping:

1: Low=1; 2: Moderate=2; 3: High=3; 4: No Correlation=0

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	1	1	1	2	2	3	3	1
CO2	3	1	3	3	3	1	1	1	2	2	3	3	1
CO3	3	2	3	3	2	1	1	1	1	2	3	2	1
CO4	3	2	3	3	2	1	1	1	1	2	3	2	1

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

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PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Inorganic Chemistry.

PSO2 - Demonstrate the knowledge of Inorganic Chemistry in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Coordination chemistry, scientific interpretation, and reaction mechanisms with an understanding on basic tools to be employed.

Weightage to content

Semester -I

Paper-II

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
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1	Structure & Bonding	2	2	36	Understanding, Application
2	Inorganic cage and ring compounds	2	2	36	Remembering, Understanding
3	Coordination compounds:	2	2	36	Application & Creation
4	Electronic spectra of transition metal complexes	2	2	36	Remembering, Understanding
	TOTAL	8	8	144	

P.R. COLLEGE (A), KAKINADA
I YEAR M Sc (Examination at the end of V semester)

Paper-II INORGANIC CHEMISTRY-I

MODEL PAPER

Duration: 3 hrs

Max. Marks: 75M

PART-A

Answer all questions

(4 × 15 = 60M)

1. (a) Derive the term symbols for d^2 and p^2 configuration and put them in the order of decreasing energy.

(OR)

(b) i) What is VSEPR theory? Explain how this model is useful in predicting the shape of molecules.

ii) Give the MO configuration of NO and O₂. Mention the bond order and magnetic properties.

2. (a) Write notes on preparation, properties and structures of carboranes.

b) i) Applications of Nanomaterials

ii) How do you account for the structures of closo, nido and arachno boranes.

3. a) What is Jahn-Teller effect? How does it influence the geometry of octahedral complexes? Explain with suitable examples.

(OR)

b) Discuss the energy level diagram for $[\text{Co}(\text{NH}_3)_6]^{3+}$ based on molecular orbital theory.

4. a) Discuss the advantages of Tanabe-Sugano diagrams compared to Orgel diagrams. Predict the possible transitions of $[\text{CoF}_6]^{3-}$ using Tanabe-Sugano diagrams.

(OR)

b) Discuss the factors affecting the paramagnetism of transition metal complexes.

PART-B

Answer any Five questions

(5 × 3 = 15M)

5. Draw the MO diagram for CO molecule and calculate their bond order.

6. Write a short account on valence bond theory.

7. Define Nano technology

8. What are three centred bonds? Explain the different types of bonds in boranes.

9. Draw and explain the crystal field splitting of orbitals in tetragonal, square planar and trigonal bipyramidal geometries.

10. What is crystal field stabilization energy? Calculate the CFSE in terms of Dq units for Mn^{3+} in weak and Fe^{3+} in strong octahedral field.

11. Write notes on spin-orbit coupling.

12. What is charge transfer spectra? How is it different from ligand field spectra?

LABORATORY COURSE

Practical Paper - I :: Inorganic Chemistry
(at the end of semester I) 6hr/week

75Marks

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Learn the systematic procedure for the semi micro qualitative analysis.
2. Acquire skills to identify the cations and the anions present in the given inorganic mixture
3. Detect the interfering anions and its elimination processes.
4. Detect the less familiar cation.
5. Acquire knowledge to prepare the Tetra ammine copper(II) sulphate, Potassium tris (oxalato) ferrate (III) trihydrate, Tris(thiourea)copper(I) sulphate

INORGANIC CHEMISTRY PRACTICALS - I

Practical (Laboratory) Syllabus:

I. Inorganic Synthesis: Preparation of

- (i) Tetraamminecopper(II) sulphate
- (ii) Potassium tris(oxalato)ferrate(III) trihydrate
- (iii) Tris(thiourea)copper(I) sulphate

II. Semi micro qualitative analysis of six radical mixtures

(One interfering anion and one less familiar cation for each mixture)

Anions: CO_3^{2-} , S^{2-} , SO_3^{2-} , Cl^- , Br^- , I^- , NO_3^- , SO_4^{2-} , CH_3COO^- , $\text{C}_2\text{O}_4^{2-}$, $\text{C}_4\text{H}_4\text{O}_6^{2-}$, PO_4^{3-} , CrO_4^{2-} , AsO_4^{3-} , F^- , BO_3^{3-}

Cations: Ammonium (NH_4^+)

1st group: Hg, Ag, Pb, Tl, W

2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo 3rd

group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be 4th

group: Zn, Mn, Co, Ni

5th group: Ca, Ba, Sr

6th group: Mg, K, Li

Lab References

S. No	Author	Title	Publisher
1	G. Svehla	Vogel's Qualitative Inorganic Analysis	Pearson.
2	E. MinShall	Systematic semi- Micro Qualitative Analysis	Mc. Donold and Evans Ltd.
3	Dr. L. Rakesh Sharma	semi- Micro Qualitative Inorganic Analysis	Mayas publication.

Scheme of valuation

1. FOR RECORD	10 Marks
2. FOR VIVA VOCE	15 Marks
3. SALT ANALYSIS ::	50 Marks
Marks Systematic Procedure should be adopted Break up of marks for Salt Analysis:	
1. Physical state & Colour	2M
2. Solubility	2 M
3. Flame test	2 M
4. Action of heat	2 M
5. Action of dil. HCl	2 M
6. Action of conc. H ₂ SO ₄	2 M
7. Action of MnO ₂	2 M
8. Action of copper turnings	2 M
9. Na ₂ CO ₃ Extract preparation	2 M
10. Three confirmation tests Anions (each test 3 marks)	9 M
11. General group separation table with all reagents	5 M
12. Identification of Cation in the correct group	3 M
13. Three Confirmation tests for Cation (each test 3 marks)	9M
14. Reporting of correct salt	6M
Total =	75M

Co-Curricular Activities:

Mandatory: (Lab/field training of students by teacher: (lab:10+field:05):

For Teacher: Training of students by teacher in laboratory and field for not less than 15 hours on the field techniques/skills of identification of cations and the anions present in the given unknown inorganic mixture.

For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for identification of cations and the anions present in the given unknown inorganic mixture. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

Max marks for Fieldwork/project work Report: 05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

a) Suggested Co-Curricular Activities

1. Training of students' by related industrial experts.

2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material

3. Visits of facilities, firms, research organizations etc.

4. Invited lectures and presentations on related topics by field/industrial experts.

	P R Govt College (A)Kakinada	Program & Semester			
Course Code	TITLE OF THE COURSE ORGANIC CHEMISTRY-I	I M Sc (I Semester)			
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites	Hybridisation, bond polarisations and migrations, EDG, EWG	60	10	30	4+3

Course Objectives:

Study the aromaticity, stereochemistry of organic compounds, heterocyclic compounds and natural products

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Nature of the organic compound
CO2	Structural orientation in 3D
CO3	Reactivity and structure of heterocyclic compounds
CO4	Structure and synthesis of natural products

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus:

UNIT - I

Nature of bonding in organic molecules and Aromaticity:

(A) **Electronic Effects** and Reactive intermediates: -Inductive effect, Mesomeric effect (Resonance), Hyperconjugation, Electromeric effect, Steric effect, Tautomerism, Generation, structure, stability and reactivity of **carbocations, carbanions, free radicals, carbenes, nitrenes and arynes**

(B) Criteria of Aromaticity: - Huckle`s rule and MO Theory, aromaticity in benzenoid non-benzenoid compounds, Aromaticity in Charged and Fused-Ring Systems, Hetero-aromatic Systems, Annulenes: Cyclobutadiene, Benzene, 1,3,5,7-Cyclooctatetraene, [10] Annulenes- [12], [14], [16] and [18]

annulenes, azulenes, fulvenes, fullerenes, ferrocene, antiaromaticity and homo-aromaticity Pseudo Aromaticity.

UNIT - II

Stereo Chemistry & Molecular representation of organic molecules:

(A) Molecular Symmetry and Chirality: Symmetry elements, Definition and classification of Stereoisomers, Enantiomer, Homomer, Epimer, Anomer, Configuration and Conformation, Configurational nomenclature: **D,L and R, S nomenclature**, Molecules with a single chiral center: Molecules with two or more chiral centers. Stereoisomerism in molecules without chiral Center -Axial chirality Allenes, Alkylidene cycloalkanes, spiranes, nomenclature. Atropsomerism: Biphenyl derivatives, nomenclature.

(B) Geometrical Isomerism and Conformations of Cyclic Systems: Cis-trans, E, Z- and Syn& anti nomenclature, Methods of determining configuration of Geometrical isomers using physical, spectral and chemical methods, Stability, Cis-trans interconversion. Conformations of cyclo butane, cyclopentane, cyclohexane, mono and disubstituted cyclo hexanes. Planar chirality: Ansa compounds, para cyclophanes, trans -cyclooctene and Helicity.

UNIT - III

Heterocyclic compounds:

(A) **Importance of heterocyclic compounds as drugs**. Nomenclature of heterocyclic systems based on ring size, number and nature of hetero atoms. Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems: Quinoline, Iso quinoline, Indole, Pyrazole, Imidazole,

(B) **Structure, synthesis and reactivity of Oxazole, Isoxazole, Pyridazine, pyrimidine and Pyrazine.**

UNIT - IV

Chemistry of some typical natural products (Alkaloids and Terpenoids):

(A) A study of the following compounds involving their isolation, structure elucidation, synthesis of Alkaloids; Atropine, Nicotine, and Quinine.

(B) A study of the following compounds involving their classification, isolation, structure elucidation, **synthesis of Alkaloids Terpenoids**: α - Terpeneol, α -Pinene and Camphor.

Unit no	Additions	Deletions	Expected levels of learning as per Blooms Taxonomy for assessment of CO	Percentage added/added
1	Electromeric effect Pseudo Aromaticity	-	K ₂ , K ₅	5%
2	-	-	-	-

3	-	-	-	-
4	-	-	-	-

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analyzing, K₅= Evaluating , K₆= Create

Reference books

S. No	AUTHOR	TITLE	PUBLISHER
1	Jerry March	Advanced Organic Chemistry: Reactions Mechanisms and Structure, 6 th Edition	John Wiley and Sons
2	Peter Sykes	A Guide Book to Mechanism in Organic chemistry, 6 th Edition	Longman
3	P.S. Kalsi	Reaction Mechanism in Organic chemistry, 2 nd Edition	New Age International press
4	R.T. Morrison and R.N. Boyd	Organic chemistry	Prentice Hall
5	E.L. Eliel	Stereochemistry to Organic compounds	John Wiley
6	P.S. Kalsi	Stereochemistry 5 th Edition	New Age International press
7	Raj.K. Bansal	Heterocyclic chemistry	
8	R.M. Achenson	An Introduction to the Heterocyclic compounds	John Wiley
9	K.W. Bentley	Chemistry of Natural Products	Tata McGraw Hill
10	D. Nasipuri	Stereochemistry to Organic compounds 2 nd Edition	New Age International press
11	R.S. Kalsi	Chemistry of natural products	Kalyani Publishers
12	William Kemp	Organic Spectroscopy	Palgrave USA

Web Links:

- 1 <https://youtu.be/R6XBNLDamgU>
- 2 <https://youtu.be/u-nzVKpzsAs>

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	1	1	2	1	3	3	1
CO2	3	3	3	3	3	1	1	1	2	1	3	3	1
CO3	3	3	3	2	2	1	1	1	2	1	3	3	1
CO4	3	2	2	3	1	2	3	1	3	1	3	3	1

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of organic Chemistry to the solution of simple to complex synthesis of organic compounds.

(PO2) Critical Thinking: Carry out experiments in the area of organic chemistry for Structural analysis and its stereochemistry of the organic Compounds and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of organic chemistry.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modeling and analyze the data obtained from sophisticated instruments for Natural product analysis.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of organic Chemistry.

PSO2 - Demonstrate the knowledge of Stereochemistry of organic Chemistry in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Heterocyclic and Natural product chemistry, scientific interpretation, and reaction mechanisms with an understanding on basic tools to be employed.

Weightage to content

Semester -I

Paper-III

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	Nature of bonding in organic molecules and Aromaticity	2	2	36	Understanding, Application
2	Stereo Chemistry & Molecular representation of organic Molecules	2	2	36	Remembering, Understanding
3	Heterocyclic compounds:	2	2	36	Application & Creation
4	Chemistry of some typical natural products (Alkaloids and Terpenoids)	2	2	36	Remembering, Understanding
	TOTAL	8	8	144	

P.R. COLLEGE (A), KAKINADA
I YEAR M Sc (Examination at the end of I semester)
Paper-III ORGANIC CHEMISTRY-I
MODEL PAPER

Duration: 3hrs

Max. Marks: 75

PART-A

Answer all questions

(4 × 15 = 60M)

1. a) i) Explain the role of inductive effect, Mesomeric effect (resonance) and Hyper conjugation in organic molecules.

(OR)

b) Define terms aromaticity, anti-aromaticity and Homo-aromaticity. Explain aromaticity in benzenoid and non-benzenoid compounds.

2. a) How do you classify organic compounds into cis-trans, E-Z and Syn-anti nomenclature. Discuss the stability of disubstituted cyclohexanes.

(OR)

b) Write an account of stereoisomerism in allenes and spiranes.

3. a) Write notes on i) Pyridazine ii) Pyrimidine and Pyrazine

(OR)

b) Describe the synthesis and reactivity of the Quinoline and Indole systems.

4. a) Outline the isolation, structure elucidation and synthesis of Atropine

(OR)

b) Outline the isolation, structure elucidation and synthesis of α -Pinene.

PART-B

Answer any Five questions

(5 × 3 = 15M)

5. Which is more basic among methyl amine, dimethyl amine and trimethylamine? Explain.

6. State and explain the Huckle's rule.

7. What are Nitrenes? Explain their reactivity with any two suitable examples.

8. Define terms invertomer, Homomer, Epimer and Anomer.

9. Write any three differences between conformation and configuration.

10. What is meant by atropisomerism? Illustrate.

11. Write the structure of Imidazole. What is the expected product(s) when this is brominated with bromine in acetic acid?

12. Depict the stereo structure of Nicotine. How many numbers of tertiary

nitrogen atoms in Nicotine?

LABORATORY COURSE

Practical Paper – II :: Organic Chemistry
(at the end of semester I) 6hr/week

75Marks

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

Prepare the Aspirin, Nerolin, Chalcone, P- Nitro acetanilide, 2,4,6 – Tri bromoaniline, M-Dinitrobenzene, Phthalimide, Diels- Alder Adduct and they can determine their melting points.

Practical (Laboratory) Syllabus:

Preparation, recrystallization, and determination of melting point & yield of the following compounds:

- i. Aspirin,
- ii. Nerolin,
- iii. Chalcone,
- iv. p-Nitro acetanilide,
- v. 2,4,6- Tri bromoaniline,
- vi. m-Dinitrobenzene,
- vii. Phthalimide,
- viii. Diels-Alder adduct

Lab References:

S. No	Author	Title	Publisher
1	J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas	Vogel's Text Book of Quantitative Chemical Analysis	Pearson Education Asia.
2	B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell	Vogel's Text Book of Practical Organic Chemistry	Longman Scientific & Technical .
3	Ahluwalia & Aggarwal R	Comprehensive Practical Organic Chemistry	University press. Delhi
4	Mann F.G and Saunders B.C	Practical Organic Chemistry	Pearson Education

Scheme of valuation

Record:	10M
Viva:	15M
Chemicals required;	5M
Chemical equations:	15M
Lab technique and procedure:	20M
Report:	10M
Total =	75M

Mandatory: *(Lab/field training of students by teacher: (lab: 10+field:05):*

For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of preparation of Aspirin, Nerolin, Chalcone, p-Nitro acetanilide, 2,4,6- Tri bromoaniline, m-Dinitrobenzene, Phthalimide, Diels-Alder adduct and the determination of melting point of organic compound.

For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand-written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

Max marks for Fieldwork/project work Report: 05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

Suggested Co-Curricular Activities

Training of students by related industrial experts.

Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.

Visits of industries, firms, research organizations etc.

Invited lectures and presentations on related topics by field/industrial experts

	P R Govt College (A)Kakinada	Program & Semester			
Course Code CHE-7A	TITLE OF THE COURSE PHYSICAL CHEMISTRY-I	I M Sc (I Semester)			
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites	Basics on thermodynamics, chemical kinetics, Photochemistry	60	10	30	4+3

Course Objectives: Study the thermodynamics and polymer chemistry and photo

1. Thermodynamics
2. Micelles and Macro molecules
3. Chemical Kinetics
4. Photochemistry

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Determination of partial molar volume: Derivation of phase rule from the concept of chemical potential. Vapour pressure- Rault's law;
CO2	molecular weight determination
CO3	studying fast reactions
CO4	Quantum yield and its determination

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus:

UNIT-I:

Thermodynamics-I:

(A) Concepts of **partial molar properties** – partial molar volume and its significance volume method. Partial molar free energy, chemical potential, Variation of chemical potential with T a; Determination of partial molar volume: Graphical method, intercept method and apparent molar v nd P. Gibbs- Duhem equation-derivation and significance. Phase equilibrium - Derivation of phase rule from the concept of

chemical potential.

(B) Ideal solutions - Thermodynamic properties of ideal solutions mixing quantities; Vapour pressure- Raoult's law; Thermodynamic properties of ideally dilute solutions. Vapour pressure- **Henry's law**, **Trouton's Law**. Non-ideal systems -Concept of fugacity, fugacity coefficient. Determination of fugacity; Non ideal solutions.

Activities and activity coefficients; Standard-state conventions for non ideal solutions; Determination of activity coefficients from vapour pressure measurements. Activity coefficients of non-volatile solutes using Gibbs- Duhem equation. Chemical equilibrium effect of temperature on equilibrium constant- Van'tHoff equation

UNIT-II:

Micelles and Macro molecules:

(A) Surface active agents, classification of surface active agents, micellization, hydro phobic interaction, critical micellar concentration (CMC), **factors affecting the CMC of surfactants**, counter ion binding to micelles, thermodynamics of micellization- phase separation and mass action models, Solubilization, micro emulsion, reverse micelles.

(B) Polymer- definition, **types of polymers**, electrically conducting, fire resistant, liquid crystal polymers, kinetics of free radical polymerization. Molecular mass- Number and mass average molecular weight, molecular weight determination-End group analysis, Osmometry, viscometry, ultracentrifugation and light scattering methods.

UNIT-III:

Chemical Kinetics:

(A) Theories of reaction rates- Collision theory- Limitations, Transition state theory. Effect of ionic strength - Debye Huckel Theory-**Primary and secondary salt effects**; Effect of dielectric constant, effect of substituent, Hammett equation-limitations, Taft equation;

(B) Prediction of rate constants- Consecutive reactions, parallel reactions ,opposing reactions (Uni molecular steps only, no derivation). Specific and general **acid-base catalysis**; Skrabal diagram; Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods.

UNIT-IV:

Photochemistry:

(A) Electronic transitions in molecules, **Franck-Condon principle**. Electronically excited molecules- singlet and triplet states, spin-orbit interaction. Quantum yield and its determination; Actinometry - ferrioxalate and uranyl oxalate actinometers-problems.

(B) Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence - E

type and P type. Photochemical primary processes, types of photochemical reactions-photo dissociation, addition and isomerisation reactions with examples.

Unit no	Additions	Deletions	Expected levels of learning as per Blooms Taxonomy for assessment of CO	Percentage added/added
1	Trounton's law	-	K ₂	2%
2	-	-	-	-
3	-	-	-	-
4	-	-	-	-

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analyzing, K₅= Evaluating , K₆= Create

Reference books

S.No	AUTHOR	TITLE	PUBLISHER
1	Peter Atkins and Julio de Paula	Physical chemisry	Oxford university Press
2	G.W. Castellon	Physical chemistry	Narosha Publishing House
3	W.J.Moore	Physical chemistry	Prentice Hall
4	Samuel Glasstone	Thermodynamics for chemists	Prentice Hall
5	K.J.Laidler	Chemical kinetics	McGraw Hill publications
6	Puri sharma and pathania	Principles of Physical chemistry	Vishal publishing Co.
7	Sabastian Koltzenburg, Michael Maskos, Oskar Nuyken	Polymer chemistry	Springer
8	V.R. Gowriker, N.V.V. Iswanadhan and J. Sreedhar	Introduction to polymer science	Wiley Publications
9	V. Morol	Micelles, Theoretical and applied aspects	Plenum Publishers

Web Links:

- 1 <https://youtu.be/75uFuS1j59o>

- 2 <https://youtu.be/CgZDTuE3vn0>
- 3 <https://youtu.be/DHPXKASQ7LE>

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	3	3	2	3
CO2	3	3	3	1	1	1	3	1	1	3	3	2	3
CO3	3	3	3	2	2	1	2	1	1	3	3	2	2
CO4	3	2	2	2	1	1	3	1	1	3	3	2	3

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Physical Chemistry to the solution of simple to complex synthesis of organic compounds.

(PO2) Critical Thinking: Carry out experiments in the area of thermodynamics and chemical kinetics for maintaining optimum conditions and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of polymer chemistry.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modeling and analyze the photo chemical processes data obtained from sophisticated instruments for chemical kinetics analysis.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Physical Chemistry.

PSO2 - Demonstrate the knowledge of thermodynamics and chemical kinetics in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of polymer chemistry, scientific interpretation, and derivations with an understanding on basic tools to be employed.

Weightage to content Semester -I Paper-IV

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	Thermodynamics-I:	2	2	36	Understanding, Application
2	Micelles and Macro molecules:	2	2	36	Remembering, Understanding
3	Chemical Kinetics:	2	2	36	Application & Creation
4	Photochemistry:	2	2	36	Remembering, Understanding
	TOTAL	8	8	144	

P.R. COLLEGE (A), KAKINADA
I YEAR M Sc (Examination at the end of
V semester)Paper-IV PHYSICAL
CHEMISTRY-I
MODEL PAPER

Duration: 3hrs

Max. Marks:75

PART-A

Answer all questions
60M)

(4 × 15 =

1. a) i) Describe the different methods of fugacity.
ii) Write a note on Henry's law.
(OR)
b) What is chemical potential? Write the influence of temperature and pressure on chemical potential.
2. a) i) Give a brief account on factor affecting critical micellar concentrations.
ii) Write a note on thermodynamic misallocation.
(OR)
b) i) Write a note on free radical polymerization.
ii) Give a brief account on light scattering method.
3. a) i) Write a note of Hammett equations.
ii) Write the kinetics of parallel reactions.
(OR)
b) i) Describe the kinetics of fast reactions explain the pressure jump method and temperature jump method.
ii) Write a note on transition state theory.
4. a) i) Derive Stern - Volmer equations.
ii) Write about delayed fluorescence.
(OR)
b) What is quantum yield? Explain the experimental determinations of quantum yield. Also write the low and high quantum yield.

PART-B

(5 × 3 = 15M)

Answer any Five questions

5. Derive Phase Rule.
6. Determinations of partial molar volume by intercept method.
7. Classifications of surfactants.
8. Write a note on mass average molecular weight.
9. Write a note on taft equation.
10. Write a note on kinetics of consecutive reactions.
11. Write a note on photo stationery state.
12. Write about internal conversion and intersystem crossing.

LABORATORY COURSE

Practical Paper – III :: Physical Chemistry
(at the end of semester I) 6hr/week

75Marks

Learning Outcomes:

On successful completion of this practical course, student shall be able to:
Acquire skills of handling the conductometer, potentiometer and the estimation of critical solution temperature of the two immiscible liquids.

Practical (Laboratory) Syllabus

1. Determination of critical solution temperature of phenol-water system.
2. Effect of added electrolyte on the CST of phenol-water system.
3. Conductometric titration of Strong acid versus Strong base
4. Dissociation constant of weak acid (CH_3COOH) by conductometric method.
5. Conductometric titration of Weak acid vs Strong base.
6. Determination of cell constant
7. Adsorption of acetic acid on animal charcoal or silica gel.
8. Acid-catalyzed hydrolysis of methyl acetate
9. Determination of partial molar volume of solute - H_2O system by apparent molar volume method.

Scheme of valua tion

Record:	10M
Viva:	15M
Chemicals and apparatus:	4M
Principle:	3M
Chemical equation:	3M
Theory and procedure:	10M
Tables:	10M
Calculation, Graphs	10M
Report:	10M
TOTAL	75M

Co-Curricular Activities

Mandatory: *(Lab/field training of students by teacher:(lab: 10+field:05):*

For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of handling the conductometer, potentiometer and the estimation of critical solution temperature of the two immiscible liquids.

For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the instrumentation. Write their observations and submit a hand-written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

Max marks for Fieldwork/project work Report: 05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

Suggested Co-Curricular Activities


Training of students by related industrial experts.

Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.

Visits of abilities, firms, research organizations etc.

Invited lectures and presentations on related topics by field/industrial experts.

SEMESTER-II

	Pithapur Rajah's Government College (Autonomous) Kakinada	Program & Semester I M.Sc. Chemistry Semester-II Paper-I			
Course Code	TITLE OF THE COURSE GENERAL CHEMISTRY - II				
Teaching	Hours Allocated: 60(Theory)	L	T	P	C
Pre-requisites:	Operators, wave mechanics	60	10	----	4

Course Objective

Study the quantum chemistry and molecular spectroscopy

Course Outcomes:

	On Completion of the course, the students will be able to
CO1	Determination of energy and wave function for one electron and many electron systems
CO2	Learning of molecular symmetry, classifying the various molecules into point groups basing on symmetry
CO3	Study of errors and learning of significant figures
CO4	Learning of FORTRAN language By using FORTRAN LANGUAGE can solve chemistry problems

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development	Employability	Entrepreneurship

Syllabus

UNIT-1

Basic Quantum Chemistry-III:

- (A) Hydrogen atom- solution of $R(r)$, $\Phi(\phi)$ and $\Theta(\theta)$ equations. Probability density in orbitals- shapes of orbitals- Perturbation theory- Time independent perturbation theory (only first order perturbation is to be dealt with)- application to ground state energy of Helium atom.
- (B) Variation principle- applications- calculation of zero-point energy of harmonic oscillator- many electrons atom- Hartree-Fock self-consistent field method (qualitative treatment only).

UNIT-II

Molecular symmetry and Group Theory in chemistry:

- (A) Basic concepts of symmetry and Group theory- Symmetry elements, symmetry operations and point groups- Schoenflies symbols- Classification of molecules into

point groups-Axioms of Group theory- Group multiplication tables for C_{2v} and C_{3v} point groups.

(B) Similarity transformations- and classes-Representations- reducible and irreducible representations, Mulliken symbols, Orthogonality theorem and its implications. Character table and its anatomy.

UNIT-III

Treatment of analytical data:

(A) Accuracy and precision- Classification of errors- Determinate and Indeterminate errors- Minimization of errors- Absolute and Relative errors, propagation of errors- Distribution of Indeterminate errors- Gaussian distribution- Measures of central tendency-Measures of precision.

(B) Standard deviation- Standard error of mean- student's test-Confidence interval of mean- Testing for significance- Comparison of two means- F-test- Criteria of rejection of an observation- Significant figures and computation rules.

UNIT- IV

Introduction to computer programming- FORTRAN 77:

(A) Basic structures and functioning of computer with P.C. as an illustrative example- Main Memory-Secondary storage memory- input/output devices- computer languages- operating systems- principles of algorithms-and flow charts-constants and variables- Arithmetic expressions- Arithmetic Statements-Replacement statement- IF statement- logical IF and BLOCK IF statements- GOTO statements- subscripted variable and DIMENSION statement. DO statement- Rules for DO statement- Functions and subroutines- Development of FORTRAN statements for simple formulae in chemistry such as Vander Waals equation- pH of a solution- First order rate equation- Cell Constant-Electrode potential.

(B) Flowcharts and computer programs for

- i) Program for the calculation of Cell Constant, Specific Conductance and Equivalence.
- ii) Rate Constant of First order reaction or Beer's law by linear least square method.
- iii) Hydrogen ion concentration of a strong acid solution/Quadratic equation
- iv) Solution for Vander Waals equation or Hydrogen ion concentration of a monoprotic weak acid
- v) Standard deviation and Variance of univariate data.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted
I	--	--		
II	--	--		
III	--	--		
IV	--	--		

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analysing, K₅= Evaluating, K₆=Create.

Text Books/Reference Books

S. No	AUTHOR	TITLE	PUBLISHER
1	A. K. Chandra	Introductory Quantum chemistry	Tata McGraw-Hill
2	A.K. Bhattacharya	Group theory for chemistry	
3	F. A. Cotton	Chemical Applications of Group Theory 3 rd Edition	CVWiley India Pvt.Ltd
4	Vogel	Vogels Textbook of Quantitative analysis	
5	Skog and West	Fundamentals of Analytical chemistry	Cengage learning
6	V. Rajaraman	Principles of computer programming (FORTRAN IBM PC)	Prentice Hall
7	P. C. Jurs	Basics of computer for chemists	
8	C.N. Banwell	Fundamentals of Molecular spectroscopy	Mc Graw Hill
9	B. K. Sharma	Molecular Spectroscopy	Krishna Prakashan
10	Aruldas	Molecular spectroscopy	
11	R. K. Prasad	Introduction to Quantum Mechanics	New age International Publications

Web Links

1. https://youtu.be/Yf_4Qv-A55Q
2. <https://youtu.be/g2sqX3FkcRo>
3. <https://youtu.be/e4VHMSO5eqM>
4. <https://youtu.be/5VZm7IsT1xM>

CO-PO Mapping

	On Completion of the course, the students will be able to
CO1	Determination of energy and wave function for one electron and many electron systems
CO2	Learning of molecular symmetry, classifying the various molecules into point groups basing on symmetry
CO3	Study of errors and learning of significant figures
CO4	Learning of FORTRAN language By using FORTRAN LANGUAGE can solve chemistry problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	1	1	1	2	2	3	3	1
CO2	3	1	3	3	3	1	1	1	2	2	3	3	1
CO3	3	2	3	3	2	1	1	1	1	2	3	2	1
CO4	3	2	3	3	2	1	1	1	1	2	3	2	1
Avg.	3	1.5	3	3	2.5	1	1	1	1.5	2	3	2.5	1

Low = 1 ; Moderate = 2 ; High = 3 ; No Correlation = 0

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Quantum Chemistry and Treatment of analytical data to the solution of simple to complex compounds.

(PO2) Critical Thinking: Carry out experiments in the area of Quantum Chemistry and Treatment of analytical data for maintaining optimum conditions and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of Group theory.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modelling and analyze the data obtained from FORTRAN 77.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and

life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Quantum Chemistry.

PSO2 - Demonstrate the knowledge of Analytical data and Group Theory in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Quantum Chemistry, scientific interpretation, and derivations with an understanding on basic tools to be employed.

PITHAPUR RAJAH'S GOVERNMENT COLLEGE, KAKINADA

PG Courses 2023-24

SYLLABUS FOR SEMESTER - II (MSC- CHEMISTRY)

Paper I (General Chemistry)

Weightage to Content

S. No.	Course Content	Essay Questions (15M)	Short Answer Questions (5M)	Total No. Of Questions from each Unit	Total No. of Marks allotted to each Unit
1	Unit - I	2	2	4	40
2	Unit - II	2	2	4	40
3	Unit - III	2	2	4	40
4	Unit - IV	2	2	4	40
	TOTAL	8	8	16	160

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA
I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)
PAPER- I: GENERAL CHEMISTRY
MODEL PAPER

Duration: 3 hrs

Max. Marks: 75

SECTION: A

Answer ALL questions.

4X15=60

1. (a) Explain Hartree - Fock self-consistent field.
(OR)
(b) Derive wave function and energy for many electron atom.
2. (a) Write a note on great orthogonal theorem and construct a character table for C_{3v}
(OR)
(b) Write a note on similarity transformation and group multiplication table for C_{3v} point group.
3. (a) Write a brief note on classifications of errors and write short note on Q - test.
(OR)
(b) Write note on calibrations methods.
4. (a) Write FORTRON program and flow chart for the variance and standard deviation.
(OR)
(b) Write a brief note on FORTRON constants and variables.


SECTION - B

Answer any FIVE questions

5X3=15

1. Write a short note on $2P_z$ orbital.
2. Write a short note on variation theorem.
3. Write group multiplication table of C_{2v} point group.
4. What is the point group of SO_4^{2-} ?
5. The titre values of A and B are 10.4, 10.5 and 10.8, 9.3, 9.5 and 9.6 respectively. Then calculate the F and T test values.
6. Write a short note on random errors.
7. Write the flow chart diagram for concentrations of H^+ ion of strong acid solutions.
8. Write algorithm for $(a+b)^2$ equation.

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	Pithapur Rajah's Government College(Autonomous) Kakinada	Program & Semester I M.Sc. Chemistry Semester-II Paper-II			
Course Code	TITLE OF THE COURSE INORGANIC CHEMISTRY - II				
Teaching	Hours Allocated: 60(Theory)	L	T	P	C
Pre-requisites:	Electronic configurations, calculation of oxidation states, trends in periodic table, shape of the orbitals, theories in bonding	60	10	30	4+3

Course Objectives:

Study of bonding theories, inorganic rings, and coordination compounds

Course Outcomes:

On Completion of the course, the students will be able to

CO1	Analyze and predict the stability and reactivity of metal cluster
CO2	Understand the bonding and electronic structure of organometallic compounds
CO3	Understand the principles of metal-ligand complex formation and their reactivity
CO4	Understand the role of metal ions in biological systems.

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus

UNIT-I

Metal cluster compounds:

(A) Definition - evidences for existence of M-M bonds - conditions favorable for formation of M-M bonds - preparation, structure, and bonding of the following metal cluster compounds. $\text{Re}_2\text{Cl}_8^{2-}$, $\text{Mo}_2\text{Cl}_8^{4-}$

(B) $\text{Re}_2(\text{RCOO})_4\text{X}_2$, $\text{Mo}_2(\text{RCOO})_4(\text{H}_2\text{O})_2$, $\text{Cr}_2(\text{RCOO})_4(\text{H}_2\text{O})_2$, $\text{Cu}_2(\text{RCOO})_4(\text{H}_2\text{O})_2$, $\text{Cr}_2\text{Cl}_9^{3-}$, $\text{Mo}_2\text{Cl}_9^{3-}$, $\text{W}_2\text{Cl}_9^{3-}$, Re_3Cl_9 , $\text{Re}_3\text{Cl}_{12}^{3-}$, $\text{Mo}_6\text{Cl}_8^{4+}$, $\text{Nb}_6\text{X}_{12}^{2+}$ and $\text{Ta}_6\text{X}_{12}^{2+}$.
Polyatomic clusters – Zintl ions, Chevrel phases

UNIT-II

Organometallic compounds:

(A) 16 and 18 electron rules. Isoelectronic relationship - Synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen, and nitric oxide complexes. Isolobal relationship - H, Cl, CH_3 , $\text{Mn}(\text{CO})_5$; CH_2 , $\text{Fe}(\text{CO})_4$; P, CH, $\text{Co}(\text{CO})_3$.

(B) Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene. Catalysis by Organometallic compounds – Homogeneous Catalysis – Alkene hydrogenation – Wilkinson's catalyst, Hydroformylation.

UNIT-III

Metal Ligand equilibria in solution:

(A) Stepwise and overall formation constants and their interaction- trends in stepwise constants – factors affecting the stability of metal complexes – Pearson's theory of hard and soft acids and bases (HSAB), chelate effect and its thermodynamic origin.

(B) Determination of stability constants of complexes – spectrophotometric method and pH-metric method. Reactivity of metal complexes – inert and labile complexes. Explanation of lability on the basis of VBT & CFT.

Bio-Inorganic Chemistry:

Metalloporphyrins with special reference to Hemoglobin & Myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Na^+ , Mg^{+2} , Co^{+3} , Zn^{+2} , Ca^{2+} .

UNIT- IV

Inorganic Reaction Mechanisms:

(A) Substitution reactions of metal complexes – D, Id, Ia and A mechanisms – Ligand replacement reactions of octahedral complexes – Acid hydrolysis – factors affecting acid hydrolysis – Anation and Base hydrolysis of Cobalt (III) complexes.

(B) Ligand displacement reactions of square planar complexes of platinum (II). Factors affecting square planar substitution – trans effect (theories). Electron transfer reactions of complexes – concept of complementary and non-complementary reactions with examples. Inner and outer sphere mechanisms.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted
III	Na^+ , Mg^{+2} , Co^{+3} , Zn^{+2}	Biological and biological Nitrogen Fixation	K_3 and K_5	

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analysing, K₅= Evaluating, K₆=Create.

Reference Books/Text Books

S.NO	AUTHOR	TITLE	PUBLISHER
1	F.A.Cotton and R.G.Wilkinson	Advanced Inorganic Chemistry,IV Edition	John Wiley and Sons
2	J.E.Huheey	Inorganic Chemistry III Edition	Haper International Edition
3	A.Singh and R.C.Mehrotra	Organometallic chemistry -A Unified Approach	Wiley Eastren Ltd
4	Shriver and Atkins	Inorganic chemistry	Oxford University press
5	M.C.Day and J.Selbin	Theoretical Inorganic Chemistry	Affiliated East West press Pvt Ltd
6	D.Benson	Mechanisms of Inorganic reactions in solutions	Mc Graw Hill,London
7	K.F.Purcell and J.C.Kotz	Inorganic chemistry	W.B.Saunders company,Newyork
8	G.N.Mukerjee and Arabinda das	Elements of Bio inorganic chemistry	U.N.Dhar and sons pvt ltd

CO-PO Mapping

On Completion of the course, the students will be able to

CO1	Analyze and predict the stability and reactivity of metal cluster
CO2	Understand the bonding and electronic structure of organometallic compounds
CO3	Understand the principles of metal-ligand complex formation and their reactivity
CO4	Understand the role of metal ions in biological systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	1	1	1	2	1	3	3	3
CO2	3	2	2	2	3	1	1	1	2	3	3	3	3
CO3	3	3	1	3	1	1	1	1	1	3	3	3	3
CO4	3	3	1	3	1	1	1	1	1	3	3	3	3
Avg.	3	2.75	1.25	2.75	1.5	1	1	1	1.5	2.5	3	3	3

Low =1 ; Moderate = 2 ; High = 3 ; No Correlation = 0

Programme Outcomes

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Organometallic Chemistry to the solution of simple to complex compounds.

(PO2) Critical Thinking: Carry out experiments in the area of Organometallic Chemistry for maintaining optimum conditions and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems in bio chemistry.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modelling and analyzing the inorganic reaction mechanism.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Organometallic Chemistry.

PSO2 - Demonstrate the knowledge of Organometallic in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Biological Chemistry ,with an understanding on bio tools to be employed

PITHAPUR RAJAH'S GOVERNMENT COLLEGE, KAKINADA
PG COURSES 2023-24
SYLLABUS FOR SEMESTER - II (MSC- CHEMISTRY)
PAPER II (INORGANIC CHEMISTRY)
WEIGHTAGE TO CONTENT

S. No.	Course Content	Essay Questions (15M)	Short Answer Questions (5M)	Total No. Of Questions from each Unit	Total No. of Marks allotted to each Unit
1	Unit - I	2	2	4	40
2	Unit - II	2	2	4	40
3	Unit - III	2	2	4	40
4	Unit - IV	2	2	4	40
	TOTAL	8	8	16	160

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA
I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)
PAPER- II: INORGANIC CHEMISTRY
MODEL PAPER

SECTION: A

Answer **ALL** questions

4X15=60

1. a) Discuss the structure and bonding of the metal clusters. $\text{Re}_2\text{Cl}_8^{2-}$ and $\text{Mo}_2\text{Cl}_8^{4-}$
(OR)
(b) Describe the structures of Trinuclear metal clusters.
2. (a) Explain the synthesis, structure and reactions of Dinitrogen complexes.
(OR)
(b) Write the preparation, structure and bonding in ferrocene.
3. (a) Describe a spectrophotometric method for the determination of stability constant of a complex.
(OR)
(b) Explain Person's concept of Hard and Soft acid and bases give examples.
4. (a) Discuss the mechanism of acid and base hydrolysis of Co(III) complex.
(OR)
(b) Explain trans effects with suitable examples. Discuss the polarization and Pi bonding theories of trans effect.

SECTION: B

Answer any **FIVE** questions

5X3=15

1. Explain the structure and magnetic property of $\text{Re}_2(\text{RCOO})_4\text{X}_2$
2. What are the favorable conditions for the formation of metal clusters?
3. What is 16 electron rule? Illustrate with suitable examples.
4. Explain Isolobal relationship with suitable examples.
5. What is meant by Chelate effect.
6. Giving suitable examples explain the liability and inertness of complexes.
7. Explain the inner sphere electron transfer mechanism.
8. What are complementary and non-complementary reactions? Explain.

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PITHAPUR RAJAH'S GOVERNMENT COLLEGE, KAKINADA
SYLLABUS FOR SEMESTER - II (MSC- CHEMISTRY)
PAPER II (INORGANIC CHEMISTRY)
PRACTICALS

Quantitative analysis:

(A) Volumetric:

1. Determination of Ferric iron by photochemical reduction
2. Determination of Nickel by EDTA
3. Determination of Calcium and Magnesium in a mixture by EDTA
4. Determination of Ferrocyanide by Ceric sulphate
5. Determination of Copper (II) in presence of Iron (III)

(B) Gravimetric:

6. Determination of Zinc as Zinc pyrophosphate
7. Determination of Nickel from a mixture of Copper and Nickel.

Reference Books/Text Books

S.NO	AUTHOR	TITLE	PUBLISHER
1	J. Mendham R. C. Denny J.D.Barnes M.J.K.Thomas	Vogel Text book of Quantitative Chemical Analysis	Pearson Education

Schem Scheme of valuation

1. Record	10 Marks
2. Viva- Voce	15 Marks
3. Practical (Quantitative analysis)	50 Marks
i. Principle with Chemical Reaction	10 Marks
ii. Brief Procedure	10 Marks
iii. Formula & Tabular forms	5 Marks
iv. Calculation	5 Marks
v. Report	
< 2% Error	20 Marks
>2% Error	15 Marks
>5% Error	10 Marks
Total	75 Marks

Cocurricular Activities

Mandatory:(Lab/field training of students by teacher:(lab:10+field:05):

For Teacher: Training of students by teacher in laboratory and field for not less than 15 hours on the field techniques/skills of Quantitative analysis-Determination of amount of solute present in given solution.

For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for Determination of amount of solute present in given solution. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

Max marks for Fieldwork/project work Report: 05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

a) Suggested Co-Curricular Activities

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.



**Pithapur Rajah's Government
College (Autonomous) Kakinada**

**Program
& Semester I M.Sc.
Chemistry
Semester-II
Paper-III**

Course Code	TITLE OF THE COURSE ORGANIC CHEMISTRY - II				
Teaching	Hours Allocated: 60(Theory)	L	T	P	C
Pre-requisites:	Different types of reactions and mechanisms, formation of alkenes & new C-C bonds.	60	10	30	4+3

Course Objectives:

Study the aromaticity, stereochemistry of organic compounds, heterocyclic compounds, and natural products

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Mechanisms of the substitution and elimination reactions, formation of alkenes.
CO2	Formation of Carbon hetero bonds through reaction mechanism and synthetic applications of the reactions.
CO3	Apply knowledge of rearrangement reactions to synthetic organic chemistry.
CO4	Structural illustration of compounds.

Syllabus:

UNIT - I

Reaction Mechanism:

(A) Aliphatic Nucleophilic Substitution and Nucleophilic Aromatic substitution:

Stereochemistry of SN2 and SN1 mechanisms, Neighboring Group Participation (Anchimeric assistance), NGP by O, S, N: Aromatic Nucleophilic substitution: SN2 (Ar) (Addition - Elimination), SN1(Ar) and benzyne mechanisms (Elimination - Addition); evidence for the structure of benzyne. Von Richter, Sommelet-Hauser rearrangements.

(B) Elimination Reactions:

Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-elimination, competition between elimination and substitution, dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations, E1cB mechanism and pyrolytic eliminations

UNIT - II

Addition Reactions

Addition to Carbon - Carbon Multiple Bonds:

Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio and chemo selectivity, orientation and reactivity,

Hydrogenation of double and triple bonds, hydrogenation of aromatic rings, Hydroboration.

Addition to Carbon-Hetero Multiple Bonds:

Steric course of addition reactions to C=O and C=N, Aldol, Cannizzaro, Perkin, Knoevenagel, Claisen-Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Reformatsky reaction, Tollen's reaction, Prin's reaction, Wittig, Grignard, Mannich, and Michael reaction.

UNIT - III

Molecular Rearrangements

Types of molecular rearrangements, migratory aptitude;

Rearrangements to electron deficient carbon: Pinacol-pinacolone, Dienone-Phenol, Arndt-Eistert synthesis. Neighboring group assistance in free radical reactions; Reactivity for aliphatic substrates; Reactivity in aromatic substrates; Reactivity at bridge head.

Rearrangements to electron deficient oxygen: Baeyer-villiger, Hydro peroxide rearrangement and Dakin rearrangements; Neber rearrangement, Benzil-Benzilic acid and Favorskii rearrangements.

UNIT - IV

Spectroscopy and Protecting Groups

(A) Spectroscopy

- i) U.V. Visible absorption laws, electronic excitations, and absorption shifts
- ii) I.R.: Fundamental modes of vibrations in IR Spectroscopy, Finger Print Region and its importance.
- iii) NMR: Chemical shift and its importance, coupling constant and its importance, Factors affecting chemical shift and coupling constant, Deuteration-deuterium exchange and Deuterium Labeling.
- iv) Mass: Some useful terms used in Mass spectrometry: Molecular ion, Fragmentation, Cleavage,
- v) Rearrangement, Loss of small molecules, Isotope Abundance, Metastable ions, Even-electron rule, Nitrogen
- vi) rule, McLafferty Rearrangement.

(B). Protection of carbonyl, Hydroxyl, carboxylic and Amine groups.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted
I	E1cB mechanism	--	K ₁ , K ₂	

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analysing, K₅= Evaluating, K₆=Create.

Text Books/ Reference Books

S. No	AUTHOR	TITLE	PUBLISHER
1	Jerry March	Advanced Organic Chemistry: Reactions Mechanisms and Structure	John Wiley and Sons
2	Peter Sykes	A Guide book to Mechanism in Organic chemistry	Longmann
3	P.S.Kalsi.	Reaction Mechanism in Organic chemistry	New Age international
4	R.T.Morrison and R,T,Boyd	Organic chemistry	Prentice Hall
5	E.L.Eliel	Stereochemistry to Organic compounds	John Wiley
6	P.S.Kalsi	Stereochemistry	New Age International
7	Raj K.Bansal	Heterocyclic chemistry	
8	R.M.Acheson ,john Wiley	An Introduction to Heterocyclic compounds	John Wiley
9	K.W.Bentley	Chemistry of Natural Products	
10	D.Nasipuri	Stereochemistry to Organic compounds	New age International
11	R.S.Kalsi	Chemistry of Natural products	Kalyani Publications

CO-PO Mapping

On Completion of the course, the students will be able to	
CO1	Mechanisms of the substitution and elimination reactions, formation of alkenes.
CO2	Formation of Carbon hetero bonds through reaction mechanism and synthetic applications of the reactions.
CO3	Apply knowledge of rearrangement reactions to synthetic organic chemistry.
CO4	Structural illustration of compounds.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	1	1	2	1	3	3	1
CO2	3	3	3	3	3	1	1	1	2	1	3	3	1
CO3	3	3	3	2	2	1	1	1	2	1	3	3	1
CO4	3	2	2	3	1	2	3	1	3	1	3	3	1
Avg.	3	2.75	2.25	2.75	2	1.25	1.5	1	2.25	1	3	3	1

Low =1 ; Moderate = 2 ; High = 3 ; No Correlation = 0

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Mechanistic chemistry to the solution of simple to complex organic reactions.

(PO2) Critical Thinking: Carry out experiments in the area of Chemical Kinetics for reaction mechanism analysis for Organic reactions.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of Organic Spectroscopy techniques.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modeling and analyze the data obtained from sophisticated instruments for protecting groups in Organic Chemistry.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the Reaction mechanism of Organic reactions.

PSO2 - Demonstrate the knowledge of Organic Spectroscopy in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Protecting groups and Organic Spectroscopy data analysis, scientific interpretation, and reaction mechanisms with an understanding on basic tools to be employed

PITHAPUR RAJAH'S GOVERNMENT COLLEGE, KAKINADA
PG COURSES 2023-24
SYLLABUS FOR SEMESTER - II (MSC- CHEMISTRY)
PAPER III (ORGANIC CHEMISTRY)
WEIGHTAGE TO CONTENT

S. No.	Course Content	Essay Questions (15M)	Short Answer Questions (5M)	Total No. Of Questions from each Unit	Total No. of Marks allotted to each Unit
1	Unit - I	2	2	4	40
2	Unit - II	2	2	4	40
3	Unit - III	2	2	4	40
4	Unit - IV	2	2	4	40
	TOTAL	8	8	16	160

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA
I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)
PAPER- III: ORGANIC CHEMISTRY
MODEL PAPER

Duration: 3 hrs

Max. Marks: 75

SECTION: A

Answer ALL questions

4X15=60

1. a) Explain the reaction mechanism and synthetic applications of Vonritcher, sommelet - Hauser and smiles rearrangement.
(OR)
b) Write short notes on E1, E2, E1CB mechanisms
2. a) Explain the mech and applications following reactions
i) Micheal ii) wittig . Iii) Claisen
(OR)
b) i) Aldol condensation ii) Reformatsky iii) Perkin
3. a) Explain the following rearrangements with mechanism.
i) Benzil- Benzillic acid ii) Beckmann iii) Bayer - Villiger.
(OR)
b) i) Wagner Merwin ii) Hoffmann. iii) Favorskii
4. a) Protection of Carbonyl, Amine, Hydroxyl groups.
(OR)
b) i) Write note on chromophore, Auxochrome, Bathochromic, Hypso effects.
ii) Discuss Base peak, MC-Lafferty rearrangement, and molecular ion.

SECTION : B

Answer any **FIVE** questions

5 X 3 = 15

1. Explain NGP in substitution reactions
2. Explain Walden Inversion
3. Explain Markovnikov's rule
4. Describe the mechanism and applications of Cannizzaro. Reaction.
5. Explain the reaction mechanism and synthetic applications of Tiffeneau - Demjanov
6. Explain the reaction mechanism and synthetic applications of Neber
7. Give the all bond frequencies in IR.
8. Write principle and importance of NMR spectroscopy.

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA

I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)

PAPER- III: ORGANIC CHEMISTRY

PRACTICALS

Course Outcomes

CO1: Develops the separation techniques for binary organic mixtures.

CO2: Analyze and identifies the functional groups of a given unknown organic compound.

CO3: Predicts the nature of organic molecules by their reactions.

CO4: Determines the physical constants accurately and precisely.

CO5: Identify the different elements present in an organic compound.

Syllabus

Systematic qualitative analysis of an organic mixture containing two compounds
Identification of method of separation and the functional group(s) present in each of them
and preparation of one solid derivative for the conformation of each of the functional group(s).

Reference Books/Text Books

S.NO	AUTHOR	TITLE	PUBLISHER
1	J. Mendham R. C. Denny J.D.Barnes M.J.K.Thomas	Vogel Text book of Quantitative Chemical Analysis	Pearson Education
2	B.S. Furniss, A.J. Hannaford, P.W.G. Smith	Vogel's Text Book of Practical Organic Chemistry	A.R. Tatchell, 5 Ed.

Scheme of Evaluation

1. Record	10 Marks
2. Viva- Voce	15 Marks
3. Practical (Qualitative analysis)	50Marks
i. Method of Separation	10 Marks
ii. Preliminary Tests (7+7)	14 Marks
State (1+1)	
Ignition test (1+1)	
Solubility (2+2)	
Test for Unsaturation (1+1)	
Extra element (2+2))	
iii. Identification Test (3+3)	6 Marks
iv. Confirmation Test (5+5)	10 Marks
v. Derivatives (3+3)	6 Marks
vi. Report (2+2)	4 Marks
Total	75 Marks

Cocurricular Activities

Mandatory:(Lab/field training of students by teacher:(lab:10+field:05):

For Teacher: Training of students by teacher in laboratory and field for not less than15 hours on the field techniques/ skills of Separation of organic compounds & Identification of functional groups present in organic compounds in a mixture, Preparation of their derivatives.

For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for Separation of organic compounds & Identification of functional groups present in organic compounds in a mixture, Preparation of their derivatives. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.


Max marks for Fieldwork/project work Report: 05.

Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

Unit tests (IE).

a) Suggested Co-Curricular Activities

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

	<p>Pithapur Rajah's Government College (Autonomous) Kakinada</p>	<p>Program & Semester I M.Sc. Chemistry Semester-II Paper-IV</p>				
<p>Course Code</p>	<p>TITLE OF THE COURSE PHYSICAL CHEMISTRY - II</p>					
<p>Teaching</p>	<p>Hours Allocated: 60 (Theory)</p>		L	T	P	C

Pre-requisites:	Basics on thermodynamics, chemical kinetics, Photochemistry	60	10	30	4+3
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Course Objectives:

Study the thermodynamics and polymer chemistry and photo chemical effects.

Course Outcomes:

On Completion of the course, the students will be able to	
CO1	Structural illustration of compounds through NMR Learning of instrumentation of NMR and ESR Study of applications of ESR spectroscopy
CO2	Study of statistical thermodynamics Study of relation between micro and macro thermodynamic properties of matter
CO3	Study of complexation effect on EMF of the cells Study of Fuel cells
CO4	Study of electrical double layer of colloidal systems Study of over voltage

Course with focus on employability / entrepreneurship / Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Syllabus

UNIT-I:

Physical methods of molecular structural elucidation:

(A) NMR: Principle and theory, Nature of spinning particle and its interaction with magnetic field. Chemical shift and its origin. Spin-Spin interaction, Application of NMR to structural elucidation- Structure of ethanol, dimethylformamide, styrene and acetophenone.

(B) Electron Spin Resonance: Principle and experimental technique- g-factor, line shapes and line widths- hyperfine interactions- applications of ESR studies.

UNIT -II:

(A) Thermodynamics-II

Brief review on entropy; entropy changes accompanying specific process - expansion, phase transition, heating, measurement of entropy. Nernst heat theorem; Third law of thermodynamics- Determination of the absolute entropy- Apparent exceptions to Third law of thermodynamics.

(B) Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, Most probable distribution Law – Partition Function, (Definition and significance): **Molar and molecular partitions**-translational, rotational, vibrational, and electronic partition functions-Relation between thermodynamic functions (E, H, S, G and C_v) and the partition functions

UNIT-III:

Electrochemistry I:

(A) Electrochemical cell- Galvanic and electrolytic cell. Concentration cell with and without transference, Effect of complexation on redox potential- ferricyanide/ferrocyanide couple, Iron (III) phenanthroline / Iron(II) phenanthroline couple. Determination of standard potential, solubility product equilibrium constant and activity coefficients from EMF data. Bjerrum theory of ion association (elementary treatment) Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient.

(B) Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required), **Calculation of mean ionic activity coefficient**; Limitations of Debye-Huckel theory. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong electrolytes. Debye Huckel- Onsagar equation – verification and limitations, Fuel Cells.

UNIT-IV:

Electrochemistry II:

(A) The electrode-electrolyte interface. The electric double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model.

(B) Electrode reactions: Charge transfer reactions at the electrode-electrolyte interface. Exchange current density and over-potential. Derivation of Butler-Volmer equation. High field approximation, Tafel equation, Low field equilibrium, **Nernst equation**, Voltammetry- Concentration polarization, experimental techniques.

Unit No	Additions	Deletions	Expected levels of learning as per Blooms taxonomy assessment of CO	Percentage added/deleted

K₁= Remembering, K₂= Understanding, K₃= Applying, K₄= Analysing, K₅= Evaluating, K₆=Create.

Text Books/ Reference Books

S. No	AUTHOR	TITLE	PUBLISHER
1	Samuel Glasstone	Text book of Physical chemistry	McMillan Pub
2	W.J. Moore	Physical chemistry	Prentice Hall
3	G.W. Castellon	Physical chemistry	N Narosha Publishing house
4	Peter Atkins and Julio, de Paula	Physical chemistry	Oxford university press
5	JOM Bockris &K.N. Reddy	Modern electrochemistry	Plenum publications
6	S. Glasstone	Introduction to Electrochemistry	East West Press
7	Banwell	Fundamentals of molecular spectroscopy	Mc Graw Hill
8	Straw and Walker	Spectroscopy	Chapman and hall
9	M.C. Gupta	Statistical thermodynamics	New Age International
10	M. Dole	Statistical thermodynamics	Prentice Hall

Weblinks

- 1 <https://youtu.be/75uFuS1j59o>
- 2 <https://youtu.be/CgZDTuE3vn0>
- 3 <https://youtu.be/75uFuS1j59o>
- 4 <https://youtu.be/CgZDTuE3vn0>
- 5 <https://youtu.be/DHPXKASQ7LE>

CO-PO Mapping

On Completion of the course, the students will be able to	
CO1	Structural illustration of compounds through NMR Learning of instrumentation of NMR and ESR Study of applications of ESR spectroscopy
CO2	Study of statistical thermodynamics Study of relation between micro and macro thermodynamic properties of matter

CO3	Study of complexation effect on EMF of the cells Study of Fuel cells
CO4	Study of electrical double layer of colloidal systems Study of over voltage

Low =1 ; Moderate = 2 ; High = 3 ; No Correlation = 0

At the completion of the M.Sc. Chemistry program, the students of our department will be able to:

(PO1) Knowledge: Apply the knowledge of Thermodynamics and Electrochemistry to the solution of simple to complex problems in chemistry.

(PO2) Critical Thinking: Carry out experiments in the area of Thermodynamics and Electrochemistry for maintaining optimum conditions and applying the domain of critical thinking.

(PO3) Problem Solving: Identify, formulate, review research literature, and analyze simple to complex problems in Thermodynamics and electrochemistry.

(PO4): Usage of modern tools: Create data using modern chemical tools and ICT for modelling and analyzing the NMR analysis of Organic Compounds.

(PO5): Communication: Develop Skills to evaluate, analyze and interpret the chemical information and data and to communicate effectively within the chemical community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO6): Life-long Learning: Demonstrate scholarly attitude to pursue a career in the field of chemical education and research and have the zeal and vision to engage in independent and life-long learning in the broadest context of technological and social change.

(PO7) Ethical Practices and Social Responsibility: Generate ideas and solutions for green and sustainable chemistry and approach towards planning and execution of research in frontier areas of chemical sciences.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of Post-graduation, our Post graduates would be able to:

PSO 1- Evaluate, analyse, interpret, and effectively apply the basic laws, principles, phenomena, processes and Experiments involved in the domain of Thermodynamics and Electrochemistry.

PSO2 - Demonstrate the knowledge of Thermodynamics and Electrochemistry in the domain of research, education and perspective entrepreneurship.

PSO3 - Evaluate distinct problems in the field of Spectroscopy with special reference to NMR spectroscopy with an understanding on bio tools to be employed

PITHAPUR RAJAH'S GOVERNMENT COLLEGE, KAKINADA
PG COURSES 2023-24
SYLLABUS FOR SEMESTER - II (MSC- CHEMISTRY)

PAPER IV (PHYSICAL CHEMISTRY)
WEIGHTAGE TO CONTENT

S. No.	Course Content	Essay Questions (15M)	Short Answer Questions (5M)	Total No. Of Questions from each Unit	Total No. of Marks allotted to each Unit
1	Unit - I	2	2	4	40
2	Unit - II	2	2	4	40
3	Unit - III	2	2	4	40
4	Unit - IV	2	2	4	40
	TOTAL	8	8	16	160

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA
I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)
PAPER- IV: PHYSICAL CHEMISTRY
MODEL PAPER

Duration: 3 hrs

Max. Marks: 75

SECTION: A

Answer **ALL** questions

4X15=60

1. What is chemical shift? Write about factors influencing chemical shift. Write NMR spectra of styrene.

(OR)

Write about principle involved in ESR spectroscopy. Write NMR spectra of Acetophenone.

2. Write a note on 3rd law of thermodynamics. Variation of entropy with pressure and volume at constant temperature.

(OR)

Derive an equation for translational partition functions. Relation between partition function and internal energy.

3. i) Write a note on concentration cell without transference.
ii) Derive standard potential from emf.

(OR)

- i) Write a note on Debye - Huckel limiting law
ii) Write a note on fuel cells.

4. i) Discuss Helmholtz - Perrin and Gouy-Chapman theory.
ii) Derive Tafel equation

(OR)

- i) Write a note on over Voltage
ii) Write a note on concentration polarization.

SECTION: B

Answer any **FIVE** questions

5 X 3 = 15

5. Write ESR spectra of CH_3 .
6. Discuss about coupling constants.
7. The enthalpy of fusion of water is 25.74 KJ note at its normal fusion point is 0°C calculate the entropy of fusion.
8. Write a short note on partition function.
9. Write a note on electrochemical cell.
10. Calculate the emf of concentration cell $\text{Ag}/\text{AgCl} (a=0.1) \text{AgCl} / \text{Ag}$ at 25°C of the transport number of Ag is 0.45.
7. What is cyclic voltammetry?
8. Calculate the ionic strength and mean activity coefficient of 1.0 m mole $\text{log}^{-1} \text{CaCl}_2$ at 25°C .

PITHAPUR RAJAH'S COLLEGE (A), KAKINADA

I YEAR MSC (EXAMINATION AT THE END OF II SEMESTER)

PAPER- IV: PHYSICAL CHEMISTRY

PRACTICALS

1. Distribution of iodine between CHCl_3 and water
2. Distribution of I_2 between CHCl_3 and aq. KI solution- calculation of equilibrium constant.
3. Determination of Coordination number of cuprammonium cation.
4. Titration of mixture Strong acid and weak acid versus Strong base by conductometry.
5. Titration of Strong acid Vs Strong Base - pH - metry.
6. Titration of mixture of $(\text{NaHCO}_3 + \text{Na}_2\text{CO}_3)$ Vs HCl - pH- metry.
7. Titration of Strong acid Vs Strong Base using Quinhydrone electrode.
8. Titration of Fe^{+2} Vs $\text{K}_2\text{Cr}_2\text{O}_7$ - potentiometry.
9. Verification of Beer-Lambert's law by Iron-thiocyanate system -colorimetry.
10. Determination of single electrode potential of $\text{Cu}^{2+} / \text{Cu}$ and estimate the given unknown concentration.

11. Adsorption of acetic acid on animal charcoal or silica gel.
12. Acid-catalyzed hydrolysis of methyl acetate.
13. Determination of partial molar volume of solute -H₂O system by apparent molar volume method.

Reference Books/Text Books

S.NO	AUTHOR	TITLE	PUBLISHER
1			
2			

Schem Scheme of valuation

1. Record	10 Marks
2. Viva- Voce	15 Marks
3. Practical	50 Marks
i. Principle with Chemical Reaction	10 Marks
ii. Brief Procedure	5 Marks
iii. Formula & Tabular forms	5 Marks
iv. Calculation	5 Marks
v. Graph	5 Marks
vi. Report	
< 2% Error	20 Marks
>2% Error	15 Marks

>5% Error

10 Marks

Total

75 Marks

Cocurricular Activities

Mandatory:(Lab/field training of students by teacher:(lab:10+field:05):

For Teacher: Training of students by teacher in laboratory and field for not less than 15 hours on the field techniques/skills of Various instrumentation techniques like Potentiometry, pH Metry, Spectrophotometer, and other laboratory techniques.

For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for Various instrumentation techniques like Potentiometry, pH Metry, Spectrophotometer, and other laboratory techniques. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

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