PERIYAR UNIVERSITY
(Accredited with 'A' Grade by NAAC)
SALEM – 636 011

M.Sc., DEGREE

[Choice Based Credit System (CBCS)]

Branch IV (A) CHEMISTRY

REGULATIONS AND SYLLABUS

[For the Candidates admitted from the academic year 2015– 2016 and onwards]

CONTENTS

I. Objectives of the Course

Life has changed more in the past two centuries than in all the previously recorded span of human history. In one-way or another, all the changes involve CHEMISTRY. Chemistry is central to the current revolutions in Science. No educated person today can understand the modern world without a basic knowledge of chemistry. The existence of a large number of chemical factories, mines and related industries in the catchments of University necessitates chemistry education. Hence our goal in introducing the M.Sc. programme in Chemistry has been to educate the undergraduate students in the fascinating fields of chemistry in an effective manner. Rigorous and comprehensive in approach, this syllabus presents essential contents in a detailed, clear and direct way.

M.Sc. Chemistry is a unique kind of course dealing with all aspects of chemistry such as preparation, properties, structure elucidation, kinetics and mechanism of the reaction, techniques of analysis for different kinds of materials, which are very essential for the human society. The major objectives of M.Sc. Chemistry course are:

- To impart knowledge in fundamental aspects of all branches of chemistry
- To acquire deep knowledge in the study of physical, chemical, electrochemical and magnetic properties, structure elucidation using various techniques and applications of various organic and inorganic materials and
- To acquire basic knowledge in the specialized areas like Polymer chemistry, Environmental Chemistry, Dye Chemistry, Pharmaceutical Chemistry etc.

This programme is offered under Choice Based Credit System (CBCS). The CBCS enables the students to select variety of subjects as per his interest and requirement. Acquiring knowledge in the related fields is advantageous to the students. The programme is structured in such a way to impart more knowledge in science, in particular in Chemistry.

II. Eligibility for Admission

A candidate who has passed B.Sc., Degree Examination with Branch IV Chemistry as main subject of study of this university or any of the B.Sc., degree examination with specialization such as Industrial chemistry, Polymer Chemistry, Applied Chemistry, Pharmaceutical Chemistry or any other specialization in Chemistry of some other university accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed thereto shall be permitted to appear and qualify for the M.Sc. degree in Chemistry of this University after a course of study of two academic years.

III. Duration of the Course

The course for the degree of Master of Science in Chemistry shall consist of two academic years divided in to four semesters. Each Semester consist of 90 working days.

IV. Course of Study

M.Sc. Chemistry - CBCS
Structure of the Course

S. No	Paper code	Title of the Paper	Hours	L	T	P	C
First Semester							
1.	15CYC101	Core Course 1- Organic Chemistry-I	72	4	1	0	4
2.	15CYC102	Core Course 2- Inorganic Chemistry-I	72	4	1	0	4
3.	15CYC103	Core Course 3- Physical Chemistry -I	72	4	1	0	4
4.	15CYE	Elective CourseI-1	72	4	0	0	4
5.	15CYC104	Core Course 4 -Organic Chemistry Practical - I	90	0	0	5	3
6.	15CYC105	Core Course 5 - Inorganic Chemistry Practical - I	90	0	0	5	3
Second Semester							
7.	15CYC201	Core Course 6 - Organic Chemistry-II	72	4	1	0	4
8.	15CYC202	Core Course 7 - Inorganic Chemistry-II	72	4	1	0	4
9.	15CYE	Elective Course -2	72	4	0	0	4
10.		Supportive Course-1	72	4	0	0	4
11.	06PHR01	Compulsory Course – Human Rights-Duties	72	4	0	0	2
12.	15CYC203	Core Course 8 - Physical Chemistry Practical - I	90	0	0	5	3
13.	15CYC204	Core Course 9 -Organic Chemistry Practical - II	90	0	0	5	3
Third Semester							
14.	15CYC301	Core Course 10 – Physical Chemistry - II	72	4	1	0	4
15.	15CYC302	Core Course 11- Organic Chemistry-III	72	4	1	0	4
16.	15CYE	Elective Course -3	72	4	0	0	4
17.		Supportive Course-2	72	4	0	0	4
18.	15CYC303	Core Course 12 - Inorganic Chemistry Practical -II	90	0	0	5	3
19.	15CYC304	Core Course 13 –Physical Chemistry Practical - II	90	0	0	5	3
Fourth Semester							
20.	15CYC401	Core Course- 14 - Inorganic Chemistry-III	72	4	1	0	4
21.	15CYC402	Core Course 15 - Physical Chemistry – III	72	4	1	0	4
22.	15CYC403	Core Course-16 Spectroscopy	72	4	0	0	4
23.	15CYE	Elective Course - 4	72	4	0	0	4
24	15CYC404	Core Course 17 - Project	252	0	0	14	8
Elective Courses							
1.	15CY E01	Analytical Chemistry	72	4	0	0	4
2.	15CY E02	Instrumental Methods of Analysis	72	4	0	0	4
3.	15CY E03	Environmental Chemistry	72	4	0	0	4
4.	15CY E04	Polymer Chemistry	72	4	0	0	4
5.	15CY E05	Chemistry of Nanomaterials	72	4	0	0	4
6.	15CY E06	Medicinal Chemistry	72	4	0	0	4
7.	15CY E07	Dye Chemistry	72	4	0	0	4
8.	15CY E08	Chemistry of Water Treatment	72	4	0	0	4
9.	15CYE09	Green Chemistry	72	4	0	0	4
10.	15CYE10	Medicinal Inorganic Chemistry	72	4	0	0	4

Supportive Courses for other Departments							
24.	15CYS01	Fundamental Aspects of Electroanalytical Techniques	72	4	0	0	4
25.	15CY S02	Conducting Polymers	72	4	0	0	4
26.	15CY S03	Industrial and Agricultural Chemistry	72	4	0	0	4
27.	15CY S04	Chemistry of Natural Products	72	4	0	0	4
28.	15CY S05	Chemistry of Industrial Products	72	4	0	0	4
29.	15CY S06	Fundamentals of Analytical Chemistry	72	4	0	0	4
30.	15CY S07	Pharmaceutical Chemistry	72	4	0	0	4
31.	15CY S08	Applied Catalysis	72	4	0	0	4

Note:

1. Human Rights – Compulsory course for All P.G. students
2. C – Core Courses, E – Elective Courses & S – Supportive Courses; L – Lecture, T – Tutorial, P – Practical
3. Credits for Core Courses 66; Credits for Elective Courses 16
   Credits for Supportive Courses 08; Total Credits 90

V. Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

VI. Examinations

The examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

Practical examinations for M.Sc. course in Chemistry will be conducted at the end of the each semester except final semester.

At the end of fourth semester viva-voce will be conducted on the basis of the Dissertation / Project report submitted by the student. One internal and one external examiner will conduct the viva-voce jointly.

VII. Scheme of Examination

M.Sc., Chemistry CBCS

S. No	Paper code	Title of the Paper	Exam Hours	I	E	T	C
First Semester							
1.	15CYC101	Core Course 1-Organic Chemistry-I	3	25	75	100	4
2.	15CYC102	Core Course 2-InOrganic Chemistry-I	3	25	75	100	4
3.	15CYC103	Core Course 3- Physical Chemistry – I	3	25	75	100	4
4.	15CYE	Elective CourseI-1	3	25	75	100	4
5.	15CYC104	Core Course 4 –Organic Chemistry Practical – I	6	40	60	100	3
6.	15CYC105	Core Course 5 Inorganic Chemistry Practical – I	6	40	60	100	3
Second Semester							
7.	15CYC201	Core Course 6- Organic Chemistry-II	3	25	75	100	4
8.	15CYC202	Core Course 7- Inorganic Chemistry-II	3	25	75	100	4
9.	15CYE	Elective Course -2	3	25	75	100	4
10.		Supportive Course-1	3	25	75	100	4
11.	06PHR01	Compulsory Course – Human Rights-Duties	3	25	75	100	2
12.	15CYC203	Core Course 8 - Physical Chemistry Practical - I	6	40	60	100	3
13.	15CYC204	Core Course 9 - Organic Chemistry Practical - II	6	40	60	100	3
Third Semester							
13.	15CYC301	Core Course 10 - Physical Chemistry – II	3	25	75	100	4
14.	15CYC302	Core Course 11- Organic Chemistry-III	3	25	75	100	4
15.	15CYE	Elective Course -3	3	25	75	100	4
16.		Supportive Course-2	3	25	75	100	4
17.	15CYC303	Core Course 12 - Inorganic Chemistry Practical -II	6	40	60	100	3
18.	15CYC304	Core Course 13 –Physical Chemistry Practical - II	6	40	60	100	3
Fourth Semester							
19.	15CYC401	Core Course- 14 - Inorganic Chemistry-III	3	25	75	100	4
20.	15CYC402	Core Course 15 – Physical Chemistry -III	3	25	75	100	4
21.	15CYC403	Core Course-16 - Spectroscopy	3	25	75	100	4
22.	15CYE	Elective Course-4	3	25	75	100	4
23.	15CYC404	Core Course 17 - Project		*50	#150	200	8
Elective Courses							
1.	15CY E01	Analytical Chemistry	3	25	75	100	4
2.	15CY E02	Instrumental Methods of Analysis	3	25	75	100	4
3.	15CY E03	Environmental Chemistry	3	25	75	100	4
4.	15CY E04	Polymer Chemistry	3	25	75	100	4
5.	15CY E05	Chemistry of Nanomaterials	3	25	75	100	4
6.	15CY E06	Medicinal Chemistry	3	25	75	100	4
7.	15CY E07	Dye Chemistry	3	25	75	100	4
8.	15CY E08	Chemistry of Water Treatment	3	25	75	100	4
9.	15CYE09	Green Chemistry	3	25	75	100	4
10.	15CYE10	Medicinal Inorganic Chemistry	3	25	75	100	4

Supportive Courses for other Departments							
24.	15CYS01	Fundamental Aspects of Electroanalytical Techniques	3	25	75	100	4
25.	15CY S02	Conducting Polymers	3	25	75	100	4
26.	15CY S03	Industrial and Agricultural Chemistry	3	25	75	100	4
27.	15CY S04	Chemistry of Natural Products	3	25	75	100	4
28.	15CY S05	Chemistry of Industrial Products	3	25	75	100	4
29.	15CY S06	Fundamentals of Analytical Chemistry	3	25	75	100	4
30.	15CY S07	Pharmaceutical Chemistry	3	25	75	100	4
31.	15CY S08	Applied Catalysis	3	25	75	100	4

*** Periodic Presentation of Learning** **50 marks**
 # Concise Dissertation 100 marks + Viva-Voce **50 marks**

VIII. Question Paper Pattern

Time: 3 Hours Max. Marks - 75

PART-A: 5x2=10

(Answer all questions)

(One question from each unit)

PART-B: 5x5=25

(Answer all questions)

(One question from each unit with internal choice)

(No Sub-Division)

1. a) or b)
2. a) or b)
3. a) or b)
4. a) or b)
5. a) or b)

PAPER-B: 5x8=40

(Answer all questions)

(One question from each unit with internal choice)

(Maximum two Sub-Divisions only)

6. a) or b)
7. a) or b)
8. a) or b)
9. a) or b)
10. a) or b)

IX. Distribution of Marks Theory and Practical Examinations

Theory (Internal marks 25)

Internal

Test	10 Marks (Average of Three Internal Tests)
Seminar	5 Marks
Assignment	5 Marks
Attendance	5 Marks
Total	25 Marks

Practical (Internal marks 40)

Internal

Class Experiments	20 marks
Model Test	10 marks
Record	10 marks
Total	40 marks

Theory - External: 75 Marks

PART-A: 5x2=10, PART-B: 5x5=25, PART-C: 5x8=40

Practicals - External : 60 marks Duration: 6 hours

Organic Chemistry Practical - I	
Qualitative organic analysis	30 marks
Preparation	15 marks
Viva – Voce in practical	10 marks
Record	5 marks
Total	60 marks

Organic Chemistry Practical - II	
Quantitative organic analysis	25 marks
Preparation	20 marks
Viva – Voce in practical	10 marks
Record	5 marks
Total	60 marks

Inorganic Chemistry Practical -I	
Qualitative analysis	30 marks
Preparation	15 marks
Viva-voce in practical	10 marks
Record	5 marks
Total	60 marks

Inorganic Chemistry Practical –II	
Quantitative analysis	30 marks
Preparation	15 marks
Viva-voce in practical	10 marks
Record	5 marks
Total	60 marks

Physical Chemistry Practical - I	
Experiment	45 marks
Viva-voce in practical	10 marks
Record	5 marks
Total	60 marks

Physical Chemistry Practical - II	
Experiment	45 marks
Viva-voce in practical	10 marks
Record	5 marks
Total	60 marks

X. Dissertation / Project Work

Concise Dissertation	150 marks
Viva-Voce	50 marks
Total	200 marks

(a) Topic:

The topic of the dissertation shall be assigned to the candidate before the end of first semester and a copy of the same should be submitted to the University for Approval.

(b) **Advisory Committee**:

Each guide shall have a maximum of five students.

There will be an advisory committee consisting of the guide as chairman and one member from the same department or allied departments of the University.

(c) **Plan of Work:**

The student should prepare plan of work for the dissertation, get the approval of the advisory committee and should be submitted to the university during the second semester of their study. In case the student wants to avail the facility from other University/laboratory, they will undertake the work with the permission of the guide and acknowledge the alien facilities utilized by them.

The duration of the dissertation research shall be a minimum of three months in the fourth semester.

(d) Dissertation Work outside the Department:

In case the student stays away for work from the Department for more than one month, specific approval of the university should be obtained.

(e) No. of copies / distribution of dissertation:

The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners. After evaluation one copy is to be retained in the Department library and one copy is to be submitted to the University (Registrar) and one copy can be held by the student.

(f) Format to be followed:

The format/certificate for dissertation to be submitted by the students is given below:

Format for the preparation of project work:

(a) Title page

(b) Bonafide Certificate

(c) Acknowledgement

(d) Table of contents

CONTENTS

Format of the Title Page:

TITLE OF THE DISSERTATION

Dissertation Submitted in part fulfillment of the requirement for the Degree of Master of Science in Chemistry to the Periyar University, Salem-636 011.

By

Students Name:

Register Number:

Department of Chemistry

Year:

Format of the Certificate:

CERTIFICATE

This is to certify that the dissertation entitled ---------- submitted in part fulfillment of the requirement of the degree of Master of Science in Chemistry to the Periyar University, Salem is a record of bonafide research work carried out by ----------under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

Date: Supervisor and Guide

Place:

Head of the Department

External Examiner:

Internal Examiner:

Guidelines for approval of M.Sc. Chemistry guides for guiding students in their research for submitting dissertation:

1. M.Sc. Chemistry (Part fulfillment) Guide:

(i) The person seeking for recognition, as guide should have:

(a) A Ph.D. Degree in Chemistry or specializations in various branches of Chemistry (or)

(b) M.Phil. / M.Sc. degree in Chemistry with first class/second class

(c) Should have 3 years of active teaching/research experience

(ii) They should have published at least one research paper in a National Journal authored solely or jointly.

2. Procedure for submitting application for approval as guides:

(i) The University will on request give prescribed application form.

(ii) The filled in applications should be submitted before the close of said date by the University.

(iii) All such applications should be routed through the HOD with specific recommendations.

(iv) All relevant proofs should be submitted along with the applications.

3. Approval:

The committee constituted for the purpose will scrutinize the applications and recommend for approval/rejection.

Orders will then be passed by the authority of the University and communicated to each member individually through the Principal.

XI. Passing Minimum

The candidate shall be declared to have passed the examination if the candidate secures a minimum of 50 % (Each in Internal and External) in the University examination.

For a pass in the Practical paper, a candidate has to secure a minimum of 50% marks in the University examination. There is no passing minimum for the record notebook. However submission of a record notebook is a must.

For the project work and viva-voce a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in that paper.

Candidates who do not obtain the required minimum marks for a pass in a paper/Project Report shall be required to appear and pass the same at a subsequent appearance.

XII. Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class.

All other successful candidates shall be declared to have passed in the Second Class.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within a period two academic years from the year of admission to the course only are eligible for University Ranking.

A candidate is deemed to have secured first rank provided he/she

(i) should have passed all the papers in first attempt itself

(ii) should have secured the highest overall grade point average (OGPA)

XIII. Maximum Duration for the Completion of the Course

The maximum duration for completion of M.Sc. Degree in Chemistry Programme shall not exceed eight semesters.

XIV. Commencement of this Regulation

These regulations shall take effect from the academic year 2015-2016.i.e., for students who are to be admitted to the first year of the course during the academic year 2015-2016and thereafter.

XV. Transitory Provision

Candidates who were admitted to the M.Sc. Degree in Chemistry with specialization in Organic/Inorganic/Physical Chemistry course of study before 2015-2016 shall be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of the examination of April/May 2018. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

XVI. Syllabus

Core Courses

First Semester

15CYC101 ORGANIC CHEMISTRY - I

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To understand the structure and reactivity of chemically active centers
2. To study the mechanism of nucleophilic and electrophilic substitution reactions

UNIT - I Types of Reactions, Mechanisms and Structure Reactivity:

1.1 Reaction intermediates: Formation, stability and structure of carbocations, carbanions, carbenes, nitrenes and free radicals.

1.2 Kinetic and nonkinetic methods of study of reaction mechanisms - Kinetic methods: primary and secondary kinetic isotopic effects, non-kinetic methods: study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Kinetic and thermodynamic control; Linear free energy relationship - Hammett equation and Taft equation, Microscopic reversibility, Hammond postulate.

UNIT - II Aromaticity:

2.1 Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds, Huckel rule, aromatic systems with other than six π electrons, non-aromatic and anti-aromatic systems with more than 10 π electrons – annulenes, azulenes and ferrocenes (synthesis not necessary). Homo-aromaticity.

2.2 Heterocycles: Nomenclature of heterocycles having not more than two hetero atoms, such as O, N and S. Synthesis and properties of imidazole, oxazole, thiazole and Pyrimidines.

UNIT - III Nucleophilic Substitution Reactions:

3.1 The S_N1, S_N2, mixed S_N1 and S_N2, S_Ni and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by σ and π bonds, anchimeric assistance. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon; Reactivity effects of substrates structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity. Reactions involving substitution at carbon doubly bonded to oxygen and nitrogen: Williamson reaction, Von Braun reaction, Claisen and Dieckmann condensation. Hydrolysis of esters

3.2 Aromatic nucleophilic Substitution - S_Nl, S_NAr, S_Ni, Benzyne mechanism. Aromatic nucleophilic substitution of activated halides - Ziegler alkyation, Chichibabin reaction.

UNIT - IV Electrophilic Substitution Reactions:

4.1 Aromatic electrophilic substitution: The arenium ion mechanism, typical reactions like nitration, sulphonation, halogenation, Friedel-Crafts alkylation, acylation and diazonium coupling, electrophilic substitution on monosubstituted benzene, orientation and reactivity - ortho, meta and para directing groups, ortho-para ratio, ipso attack, Gatterman, Gatterman-Koch, Vilsmeier, Reimer-Tiemann reaction.

4.2 Aliphatic electrophilic substitution - S_E2 and S_E1 mechanisms, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity

UNIT - V Stereochemistry:

Fundamentals of organic Stereochemistry: Projection Formulae: Fischer, Newman and Sawhorse projections and their interconversions. Homotopic, enantiotopic and diastereotopic atoms and groups in organic molecules; Optical activity in the absence of chiral carbon-biphenyls, allenes and spiranes. R-S notations; Chirality due to helical shape – trans cyclooctene. E-Z isomerism of olefins containing one double bond and more than one double bonds; Definition of prochirality - Asymmetric synthesis - Crams rule.

Text Books:

1. Jerry March, **Advanced Organic Chemistry-Reactions, Mechanisms and Structure**, Fourth Edition, John Wiley & Sons ,1992
2. **Structures and Mechanism** by E.S. Gould
3. **Carbenes, Nitrenes and Arynes** by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London.
4. Francis A. Carey, **Organic Chemistry**, Third Edition, McGraw-Hill Companies, Inc., 1996.
5. P.S. Kalsi, **Organic Reactions and Mechanisms**, Second Edition, New Age International Publishers, 2002.
6. **Stereochemistry and Mechanism through solved problems** by P.S. Kalsi. Wiley Eastern Ltd., (1994)
7. Ernest L. Eliel, **Stereochemistry of Carbon Compounds**, T.M.H Edition, Tata McGraw-Hill Publishing Company, 1995.
8. **Organic Reaction Mechanism** by R.K. Bansal.
9. **A Guide book to mechanism in organic chemistry** by Longman.
10. **Structure and mechanism in organic chemistry** by C.K. Ingold, Cornell University press
11. **Aromatic Nucleophilic Substitution** by J. Miller

15CYC102 INORGANIC CHEMISTRY - I

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To understand the structure, bonding and properties of boron compounds**,** clusters & Solids
2. To study the types of Nuclear Reactions and Applications of Radioisotopes

UNIT I Structure and Bonding

Van der Waals bonding, Hydrogen bonding; HSAB concept; polyacids - Isopolyacids of V, Mo and W; Heteropolyacids of Mo and W (only structural aspects). Inorganic polymers - silicates - structure, properties, correlation and application; Molecular sieves; polysulphur nitrogen compounds and polyorganophosphazenes. Allotropes of carbon (graphite, diamond, fullerenes) and their properties.

UNIT II Boron Compounds and Clusters

Boron hydrides, polyhedral boranes, hydroborate ions- a general study of preparation, properties, Wade's rule, Styx notation and structure; Carboranes - types such as closo and nido, preparation, properties and structure; Metallo carboranes - a general study; Metal clusters- chemistry of low molecularity metal clusters only, multiple metal-metal bonds.

UNIT III Structure and Properties of Solids

Structure of solids: Structure of Pyrovoskite, Cadmium iodide, Nickel arsenide; Spinels – Structure and formation: defects in solids, non-stoichiometric compounds. Electrical, magnetic and optical properties of solids, band theory, semiconductors, superconductors, solid state electrolytes. Types of magnetic behavior – Dia, para, ferro, antiferro and ferrimagnetism; Hysterisis, solid state lasers, inorganic phosphors, ferrites. Reactions in solid state and phase transitions, diffusion, diffusion coefficient, diffusion mechanisms, vacancy and interstitial diffusion, formation of spinels.

UNIT IV Nuclear Reactions

Radioactive decay, mass defect, binding energy and exchange forces; Models of nucleus - shell model and liquid drop model; orbital electron capture; nuclear isomerism; internal conversions; Q value; nuclear cross section; threshold energy and excitation functions.

Different type of nuclear reactions with natural and accelerated particles-transmutation, stripping and pick-up, spallation, fragmentation, fission; Characteristic of fission reaction, product distribution and theories of fission; fissile and fertile isotopes - U^{235}, U^{238}, Th^{232} and Pu^{239}; atom bomb; nuclear fusion - Steller energy; Synthesis of new elements.

UNIT V Detection of Radioactivity and Applications of Radioisotopes

Cloud chamber, nuclear emulsion, bubble chamber, proportional counters, G.M. Counter, Scintillation counters and Cherenkov counters. Particle accelerators - Linear accelerator, Cyclotron, Synchrotron, Betatron and Bevatron.

Applications of radioisotopes in analysis – agriculture, industry, medicine, mechanism of chemical reactions; uses of radioisotopes in analytical chemistry; isotopic dilution analysis; neutron activation analysis and dating methods.

Text Books

1. H.J. Emelius and Sharpe, Modern aspects of Inorganic chemistry, Universal book Stall, New Delhi, 1989.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry- Principles of structure and reactivity, 4th edition, Pearson-Education, 2002.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern, 5th edition, 1988.
4. S. Glasstone, Source book of atomic Energy, Van Nonstrand Co., 1969.
5. H.J. Arniker, Essentials of nuclear chemistry, 2nd edition Wiley eastern Co.,1987.
6. A. R. West, Basic Solid State Chemistry, John Wiley Sons, 1991.

Reference Books

1. E.L. Mutteri, Polyhedral boranes, Acadamic press, NY, 1975.
2. N.H. Ray, Inorganic polymers, Academic press, NY, 1975.
3. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB Saunders Co. USA 1977.
4. G.S. Manku, Inorganic Chemistry, TMH Co., 1984.
5. A.K. Srivatsava and P.C. Jain, Elements of Nuclear Chemistry, S. Chand and Co., 1989.
6. G. Friedlander, J.W. Kennedy and J.M. Miller, Nuclear and Radiochemistry, Wiley, 1964.
7. A. Muller, Inorganic Structural Chemistry, Wiley, New York, 1993.

15CYC103 PHYSICAL CHEMISTRY – I

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To understand the kinetics, theory and mechanism of various reactions
2. To study the theory and mechanism of catalytic and surface reactions
3. To understand the concepts of photochemistry

UNIT-I CHEMICAL KINETICS -I

Rates of Chemical reactions-Temperature dependence of chemical reactions-Methods of determining rate laws; Determination of reaction mechanisms-Elementary, consecutive and parallel reactions-Theories of reaction rates - simple collision theory, ARR theory; Arrhenius and Eyring equations - Potential energy surfaces ; Treatment of unimolecular reactions (Lindemann-Hinselwood and Rice-Ramsperger-Kassel-Marcus[RRKM] theories);

UNIT –I I CHEMICAL KINETICS - II

Reaction rates in solution; factors determining reaction rates in solution; dielectric constant and ionic strength-kinetic isotopic effect-salt effects; Linear free energy relationships- Hammett and Taft equation – Hammett acidity function ; Fast reactions- flow methods, relaxation method, flash photolysis and magnetic resonance method; reactions in crossed molecular beams; Shock tube technique; Marcus theory of electron transfer reactions.

UNIT – III CATALYSIS

Characteristics of catalytic reactions; pH and temperature dependence of rate constants of catalysed reactions- Acid base catalysis- Bronsted relation- Homogeneous catalysis; Heterogeneous catalysis; Langmuir-Hinshelwood mechanism-Rideal-Eley mechanism-; Enzyme catalysis-kinetics and mechanism of enzyme catalysed reactions-Michaelis-Menton kinetics; Factors affecting enzyme catalysis; Micellar catalysis;

UNIT – IV SURFACE CHEMISTRY

Kinetics of surface reactions- unimolecular and bimolecular reactions; Adsorption of gases on solids-factors affecting adsorption-Surface area and its determination; Adsorption isotherms-Theory, derivation and applications of Freundlich, Gibbs, Langmuir, Temkin and BET adsorption isotherms.

UNIT – V PHOTOCHEMISTRY

Photophysical processes ; radiative and non radiative processes-Theory of radiationless transitions- reaction paths of electronically excited molecules; - Jablanski diagram; fluorescence and phosphorescence; factors affecting fluorescence-prompt and delayed fluorescence-fluorescence quenching-static and dynamic quenching; Excimers and exciplexes; Quantum yield measurement – kinetics of photochemical reactions; Stern-Volmer equation; solar energy conversion and storage.

Text Books

1. J. Rajaram and J.C. Kuriacose, **Kinetics and Mechanism of Chemical Transformations**, MacMillan India Ltd., 1993.
2. K.K.Rohatgi Mukherjee, **Fundamentals of photochemistry,** Wiley Eastern Ltd.,New York, 1978.
3. A.W.Adamson, **Physical Chemistry of surfaces**, 4th edn., Wiley - Interscience, Newyork, 1982.
4. P.W.Atkins, **Physical Chemistry,** Oxford University Press, Oxford, 1990.
5. D.A. McQuarrie, **Text Book of Physical Chemistry**, University Science Books, Mill Valley, California, 1983.
6. R.A. Alberty and R.J.Silbey, **Physical Chemistry**, John Wiley and Sons, New York, 1992

Reference Books

1. R.G. Frost and Pearson, **Kinetics and Mechanism**, Wiley New York, 1961

2. C.Capellos and B.H.J.Bielski, **Kinetic Systems**, Wiley Interscience, New York, 1968.

1. K.J.Laidler, **Chemical Kinetics**, Harper and Row, New York,1987.

2. R.G. Frost and Pearson, **Kinetics and Mechanism**, Wiley New York, 1961

3. G.M. Harris, **Chemical Kinetics**, D.C. Healthand Co., 1966.

4. A.W.Anderson, **Physical Chemistry of Surfaces**, Wiley - Interscience, Newyork, 1990.

5. N.J.Turro, **Modern molecular photochemistry,** Benjamin/Cummings, Menlo Park, California, 1978

15CYC104 ORGANIC CHEMISTRY PRACTICAL - I

Hours	L	T	P	C
90	4	0	5	3

Objectives

1. To separate and identify the components in the binary organic mixture.
2. To familiar with some single stage preparation of organic compounds.

- **Identification of components** in a two component mixture and preparation of their derivatives.
- **Preparation of organic compounds (single stage)**
    1. *β*-naphthyl methyl ether from *β*-naphthol (methylation)
    2. *β*-glucose penta acetate from glucose (acetylation)
    3. *ortho* - Benzoyl benzoic acid from phthalic anhydride (Friedel-Crafts)
    4. Resacetophenone from resorcinol (acetylation)
    5. Methyl orange from sulphanilic acid (diazocoupling)
    6. Anthraquinone from anthracene (oxidation)
    7. Methyl-m-nitrobenzoate from methylbenzoate (nitration)

Text Books:

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, **Vogel's Practical Organic Chemistry.** 5th edn. ELBS, 1989
2. Raj K. Bansal, **Laboratory manual of Organic Chemistry**, III Edn., New Age International (P) Ltd. 1996.
3. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab Manual, New Ed., SV Publishers 2006

15CYC105 INORGANIC CHEMISTRY PRACTICAL – I

Hours	L	T	P	C
90	4	0	5	3

1. Semimicro Qualitative Analysis

Qualitative analysis employing semimicro methods and spot tests of mixtures of common cations and ions of the following less familiar elements: Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, Titanium, Zirconium, Vanadium, Beryllium, Uranium and Lithium.

2. Preparations

About ten preparations involving different techniques selected from the following: dipyridinium hexachloroplumbate, ortho and para- hydroxyphenylmercuric chloride, potassium cupricchloride, chrome alum, tris(thiourea)copper(I)nitrate, potassium trisoxalatoaluminate(III), potassium trisoxalatochromate(III), potassium trisoxalatoferrate(III), hexamminecobalt(III) chloride, chloropentamminechromium(III) nitrate, tetramminecopper(II) sulphate, ammonium hexachlorostannate(IV).

3. Colorimetric Estimations:

Estimations of (using Nessler technique and/or spectrophotometry) Copper, Iron, Nickel and Chromium.

Note: A minimum of six inorganic mixtures containing, two common and two rare elements should be analysed by a student. Each student should do a minimum of six preparations.

Reference Books

1. G. Svehla, Vogel's Qualitative Inorganic analysis, VI Edition, Orient Longman, 1987.

2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis, National Publishing Co., 1971.

Second Semester

15CYC201 ORGANIC CHEMISTRY – II

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To learn the concepts of Elimination and Pericyclic reactions
2. To know the importance of Steroids and Terpenoids with stereochemical aspects

UNIT - I Elimination and addition reactions

E_1, E_2, E_1CB mechanisms, Orientation of the double bond - Hofmann and Saytzeff rule, competition between elimination and substitution, dehydration and dehydrohalogenation reactions, stereochemistry of E_2 eliminations in cyclohexane ring systems, mechanism of pyrolytic eliminations, chugaev reaction and Cope elimination.

Addition to Carbon - Carbon and Carbon - Hetero atom Multiple bonds: Addition of halogen and nitrosyl chloride to olefins, hydration of olefins and acetylenes, hydroboration, hydroxylation, epoxydation, Michael addition, 1,3-dipolar addition.

Mechanisms of Mannich, Stobbe, Darzen Glycidic ester condensation, Benzoin condensation, Peterson olefination (Silyl Wittig reaction), Strecker synthesis, Wittig, Wittig - Horner, Perkin, Thorpe, Ritter and Prins reactions.

UNIT - II Conformational Analysis:

Conformational analysis of simple cyclic (chair and boat cyclohexanes) and acyclic (n-butane) systems, conformation of simple 1,2 disubstituted derivatives - ethylene chlorohydrin and ethylene glycol, Conformational analysis and stereochemical features of disubstituted cyclohexanes (1,2; 1,3; 1,4 dialkylcyclo hexanes), conformation and stereochemistry of cis and trans decalins, effects of conformation on reactivity in acyclic and cyclohexanes, Oxidation and acylation of cyclohexanols, reduction of cyclohexanones, esterification and hydrolysis of cyclohexane carboxylic acid derivatives.

UNIT - III Organic Photochemistry

Organic photochemistry: Introductory theory of light absorption, photophysical processes – Jablonski diagram, energy transfer, photochemical reaction of ketones and enones, Norrish type I and type II reactions, photooxidation and photoreduction. Paterno - Buchi reaction, cis and trans isomerization and photochemistry of aromatic compounds. Di- pi-methane rearrangement.

UNIT IV Pericyclic reactions

Concerted reactions: Pericyclic reactions - the electrocyclic reactions, cycloaddition reactions and sigmatrophic reactions. Analysis of pericyclic reactions - FMO approach - Woodward - Hofmann rules, orbital correlation diagrams. Aromatic transition state concept; Diels-Alder reaction, Cope and Claisen rearrangements

UNIT - V Steroids and Terpenoids:

5.1 Steroids: Structure and Stereochemistry of Cholesterol. Total synthesis of Cholesterol and estrone; Conversion of cholesterol into progesterone, testosterone and oestrone; Artificial hormones - Stilboestrol and Hexoestrol.

5.2 Terpenoids: Structure, Stereochemistry and synthesis of zingiberene, cadinene and abeitic acid

Text Books:

1. Jerry March, **Advanced Organic Chemistry-Reactions, Mechanisms and Structure**, Fourth Edition, John Wiley & Sons (1992)

2. Francis A. Carey, **Organic Chemistry**, Third Edition, McGraw-Hill Companies, Inc., 1996.

3. P.S. Kalsi, **Organic Reactions and Mechanisms**, Second Edition, New Age International Publishers, 2002.

4. P.S. Kalsi, **Stereochemistry - Conformation and Mechanism**, 6th Edition, Wiley Eastern Limited, 2005.

5. I.L. Finar, **Organic Chemistry**, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)

Reference Books:

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, **Organic Chemistry,** IV Edn., McGraw Hill Company, 1980.

2. S.M. Mukherji and S. P. Singh, **Reaction Mechanism in Organic Chemistry**, 1st Edition, Macmillan, 1976.

3. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, Prentice-Hall, 1992.

4. R.O.C. Norman, **Principles of Organic Synthesis**, Second Edition, Chapman and Hall, 1978.

5. S.M. Mukherji and S.P. Singh, **Reaction Mechanism in Organic Chemistry,** III Edn. 1984. MacMillan.

15CYC202 INORGANIC CHEMISTRY – II

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To understand the theories of bonding in coordination compounds and reaction mechanism of transition metal complexes
2. To study the theory, stability, stereochemical aspects and magnetic properties of metal complex**es**
3. To understand the chemistry of lanthanides and actinides

UNIT I Metal-Ligand Bonding

18 Electron rule; EAN rule, theories of coordination compounds - valence bond theory, crystal field theory - splitting of d-orbitals in different symmetries, crystal field stabilization energy, factors affecting the magnitude of 10 Dq, evidence for crystal field stabilization, spectrochemical series, site selection in spinels, tetragonal distortion from octahedral symmetry, Jahn-Teller distortion; Molecular Orbital Theory - octahedral complexes, tetrahedral and square planar complexes, pi bonding and molecular orbital theory, experimental evidence for pi-bonding.

UNIT II Electronic Spectra and Magnetic Properties

Term states of d^n ions - microstates and their classifications, electronic spectra of coordination compounds - selection rules, band intensities and band widths; energy level diagrams of Orgel and Tanabe - Sugano diagram; spectra of Ti^{3+}, V^{3+}, Ni^{2+}, Cr^{3+}, Co^{2+}, Cr^{2+} and Fe^{2+}; calculation of 10Dq and B for V^{3+} (oct) and Ni^{2+} (oct) complexes.

Magnetic properties of coordination compounds - change in magnetic properties of complexes in terms of spin-orbit coupling; spin only moments of d^n systems; temperature independent paramagnetism; spin cross over phenomena.

UNIT III Stability and Stereochemical Aspects

Stability of complexes - thermodynamic aspects of complex formation, factors affecting

stability, stability correlations, statistical and chelate effects; Determination of stability constants - polarographic, photometric and potentiometric methods.

Stereochemical aspects - stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation, chirality.

Macrocyclic ligand types - porphyrins, corrins, Schiff bases, crown ethers, cryptates and catenands. (simple complexes).

UNIT IV Reaction Mechanism of transition metal complexes

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitutions, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reactions. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT V Chemistry of lanthanides and Actinides

Electronic configurations, physical and chemical properties, stable oxidation states, the lanthanide contractions, spectral and magnetic properties of the compounds of lanthanides and actinides in comparison with the compounds of transition metals; Structure and bonding in highly coordinated lanthanide and actinide complexes; Uses of lanthanide compounds as shift reagents. Synthesis of elements; extraction of Th and U; technical production of Pu.

Text Books

1. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry- Principles of structure and reactivity, 4th edition, Pearson-Education, 2002.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern 1988.
3. S.F.A. Kettle, Co-ordination compounds, ELBS, 1973.
4. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., NY. 1974.

5. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB. Sanders Co., USA 1977.

6. D. F. Shriver, P. W. Atkins and C.H. Longford, Inorganic Chemistry, ELBS, 2nd edition, 1994.

7. R.B. Heslop and K. Jones, Inorganic Chemistry, Elsevier, 1976.

8. W.U.Malik, G.D.Tuli, R.D.Madan, Selected topics in Inorganic Chemistry, S.Chand & Co., 2004.

Reference Books

1. D. Bannerjea, Co-ordination Chemistry, Tata-McGraw Hill, 1993.

2. M.L. Tobe, Inorganic Reaction Mechanism, Nelson, 1972.

3. K. Burger, Coordination Chemistry Experimental Methods, Butterworths, 1973.

4. B.N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, New Delhi, 1976.

5. F. Basolo and R.G. Pearson, Mechanism of Inorganic Reactions, Wiley Eastern, 1967.

B.R.Puri, L.R.Sharma, K.C.Kalia, Principles of Inorganic Chemistry, Milestone Publishers, 2013.

15CYC203 PHYSICAL CHEMISTRY PRACTICAL – I

Hours	L	T	P	C
90	4	0	5	3

Experiments in chemical kinetics, phase rule, Chemical equilibrium and Conductivity measurements:

DETAILED LIST OF EXPERIMENTS

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. A minimum of 15 experiments have to be performed in a year.

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethylacetate.

2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half life method and determine the order with respect to iodine and acetone.

3. Study of the saponification of ethylacetate by sodium hydroxide conductometrically and determine the order of the reaction.

4. Determination of association factor of benzoic acid in benzene by distribution method.

5. Study the phase diagram for m-toluidine and glycerine system.

6. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine)

7. Construction of the phase diagram of the three component of partially immiscible liquid systems (DMSO – Water – Benzene; Water-Benzene –Acetic acid; Ethyl alcohol – Benzene – Water; Acetone-Chloroform – Water; Chloroform – Acetic acid-Water).

8. Determination of the equilibrium constant of the reaction between Iodine and KI by partition method.

9. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.

10. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.

11. Conductometric titrations of a mixture of HCl and CH_3COOH against Sodium hydroxide.

12. Compare the relative strength of acetic acid and monochloroacetic acid by conductivity method.

Reference Books

1. B.P. Levitt (Ed.). Findlay's Practical Physical Chemistry, 9^{th} Edn., Longman, London, 1985.

2. J.N. Gurtu and R.Kapoor, Advanced Experimental Chemistry, Vol I. S. Chand & Co. Ltd., New Delhi, 1980.

15CYC204 ORGANIC CHEMISTRY PRACTICAL – II

Hours	L	T	P	C
90	4	0	5	3

Objectives

1. To analyse the organic compound Quantitatively
2. To execute double stage preparation of organic compounds

I Quantitative analysis of organic compounds

Estimation of :

i. Phenol
ii. Aniline
iii. Ketone
iv. Glucose
v. Saponification value of an oil
vi. Iodine value of an oil

II Preparation of organic compounds (Double stage)

i. *p*-Bromoacetanilide from aniline (acetylation and bromination)
ii. Acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation)
iii. 1,3,5-Tribromobenzene from aniline (bromination, diazotization and hydrolysis)
iv. *p*-Nitroaniline from acetanilide (nitration and hydrolysis)
v. Benzanilide from benzophenone (Beckmann rearrangement)
vi. *p*-Bromoaniline from acetanilide (bromination and hydrolysis)
vii. *m*-Nitroaniline from nitrobenzene (Nitration and reduction)

Text Books:

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, **Vogel's Practical Organic Chemistry.** 5th edn. ELBS, 1989
2. Raj K. Bansal, **Laboratory manual of Organic Chemistry**, III Edn., New Age International (P) Ltd. 1996.
3. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab Manual, New Ed., SV Publishers 2006

Third Semester

15CYC301 PHYSICAL CHEMISTRY - II

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the concepts of quantum chemistry and thermodynamics
2. To study the concepts of chemical and phase equilibria

UNIT-I Quantum Chemistry

Inadequacy of classical mechanics; Plancks Quantum theory of radiation – Compton effect-Photo electric effect – the hydrogen spectrum – Failure of Bohr's model.; Heisenberg's uncertainly principle – wave particle dualism – Davisson, Garmer experiments; Operators-Linear, Hermitian and Hamiltonian; Operator algebra; Postulates of quantum mechanics; The Schrodinger equation-Application to simple systems:Particle in a box (one, two and three dimensional systems) -harmonic oscillator, rigid rotator, hydrogen atom; -Commutation relation; Spin-orbit interaction; shapes of atomic orbitals; orbital and spin angular momenta; tunneling.

UNIT-II Quantum Chemistry-II

Approximation methods-variation method-appication to harmonic oscillator, hydrogen and helium atoms; perturbation theory up to second order in energy; applications;Born-Oppenheimer approximation- VB and MO theories; Application to hydrogen molecule; Huckel pi- electron theory and its applications to ethylene, butadiene and benzene Calculation of electron density and bond order; Semi emprical methods- Slater determinant for n-electron atoms Hartree and Hartree – Fock self consistent field method; many-electron systems and antisymmetry principle.

UNIT-III Thermodynamics

First, second and third laws of thermodynamics; Absolute entropy- state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; Temperature and pressure dependence of thermodynamic quantities;Free energy ; partial molar

quantities; fugacity, and fugacity coefficient; Determination of fugacity; activity and activity coefficient; Variation of chemical potential with temperature and pressure; Gibbs-Duhem equation;. thermodynamics of ideal and non-ideal gases, and solutions.

UNIT-IV Chemical and Phase Equilibria

Chemical equilibrium – Spontaneity and equilibria; response of chemical equilibrium to temperature and pressure- thermodynamic derivation of equilibrium constant – standard free energy– calculations; Le Chatelier principle;. Elementary description of phase transitions; Phase equilibria- phase rule and phase diagrams- thermodynamic derivation and application of phase rule – one, two and three component systems- Colligative properties;

UNIT- V Non-equilibrium thermodynamics &Statistical thermodynamics

Thermodynamic criteria for non-equilibrium states; postulates and methodologies of non-equilibrium thermodynamics; phenomenological laws; entropy production; Onsager reciprocal relations- Kinetic theory of gases; –Statistical approach to the third law of Thermodynamics; Sackur tetrode equation; Boltzman distribution law; Maxwel-Boltzman, Bose-Einstein and Fermi-Dirac statistics; vibrational, rotational and electronic partition functions and their relation to thermodynamic functions ; heat capacity and equilibrium constants; Theories of specific heats of solids; Concept of negative absolute temperature.

Text Books

1. R.K.Prasad, **Quantum Chemistry**, Wiley Eastern, New Delhi,1992.
2. D.A. McQuarrie, **Quantum Chemistry**, University Science Books, Mill Valley, California, 1983.
3. P.W.Atkins, **Physical Chemistry,**Oxford University Press; Fifth edition ,2012.
4. D.A. McQuarrie, **Text Book of Physical Chemistry**, University Science Books, Mill Valley, California, 1983.
5. R.A. Alberty and R.J.Silbey, **Physical Chemistry**, John Wiley and Sons, New York, 1992

6. J. Rajaram and J.C. Kuriacose, **Thermodynamics for Students of Chemistry**, Lal Nagin Chand, New Delhi, 1986.

7. M.C. Gupta, **Statistical Thermodynamics**, Wiley Eastern, New Delhi,1990.

8. Yi-Chen Cheng, **Macroscopic and Statistical Thermodynamics**, World Scientific (2006).

9. J. Rajaram and J.C. Kuriacose, **Irreversible Thermodynamics,** Lal Nagin Chand, New Delhi, 1989.

10. A.L.Lehninger, **Bioenergetics,** W.A.Benjamin Inc.,New York, 1965.

11. W.Hoppe, W.Lohmann, H.Markl and H.Uiegler, **Biophysics,** Springer-Verlag, 1983.

Reference Books

1. P.W. Atkins, **Molecular Quantum Mechanics**, Oxford University Press, Oxford, 1983

2. M.W.Hanna, **Quantum Mechanics in Chemistry**, W.A.Benjamin Inc. London 1965

3. S. Glasstone, **Thermodynamics for Chemists**, Affiliated East West Press, New Delhi 1960.

4. R.P.H.Gasser and W.G.Richards, **Introduction to Statistical Thermodynamics**, World Scientific, Singapore, 1995.

5. I.N. Levine, **Quantum Chemistry**, Allyn and Bacon, Boston, 1983

6. H. Eyring, J. Walter and G.Kimball, **Quantum Chemistry**, John Wiley and Sons, New York, 1944.

7. M.W. Hanna, **Quantum Mechanics in Chemistry**, W.A. Benjamin Inc. London, 1965.

8. R.K.Prasad, **Quantum Chemistry**, Wiley Eastern, New Delhi,1992.

15CYC302 ORGANIC CHEMISTRY III

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the Retero-synthetic analysis of complex organic molecules and molecular rearrangements.
2. To learn the applications of important reagents in organic synthesis.

UNIT - I Disconnection Approach:

1.1 An introduction to synthons and synthetic equivalents, disconnection approach: The importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polaritiy, cyclization reactions, amine synthesis.

1.2 One group C-C disconnections - Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, Olefination of carbonyl compounds - McMurry's method.

1.3 Two group C-C disconnections - Diels Alder reaction, Michael addition.

UNIT - II Reagents in Organic Synthesis:

2.1 Synthesis of simple organic molecules using standard reactions like acylation and alkylation of enamines and active methylene compounds. Protection and deprotection of functional groups (R-OH, R-CHO, RCOR, R- NH_2 and R-COOH)

2.2 Reagents and their uses: DCC, trimethylsilyl iodide, trimethylsilyl chloride, 1,3-dithiane (umpolung), diisobutylaluminium hydride (DIBAL), 9-BBN, Osmium tetroxide, DDQ, Selenium dioxide, Phase transfer Catalysts.

UNIT - III Molecular Rearrangements:

A detailed study of the mechanism of the following rearrangements: Nucleophilic, Electrophilic and Free radical rearrangements - memory effects, migratory aptitudes, Wagner-Meerwin, Demyanov, Dienone-Phenol, Favorski, Baeyer-Villiger, Wolff, Stevens, Von-Richter, Clasien, Beckmann and Fries rearrangements (a few examples in each rearrangement are to be studied).

UNIT - IV Oxidation and Reduction Reactions:

4.1 Study of the following oxidation reactions with mechanism: Oxidation of alcohols by CrO_3, DMSO alone, DMSO in combination with DCC; acetic anhydride and oxalyl chloride, oxidation of arylmethane, oxidation of methylene alpha to carbonyl, allylic oxidation of olefins, oxidative cleavage of glycols, oxidative cleavage of double bonds by ozonolysis.

4.2 Study of the following reduction reactions with mechanism; Reduction of carbonyl compounds by hydrides, selectivity in reduction of 4-ter-butyl cyclohexanone using selectrides,

clemmensen and Wolff Kishner reductions, Birch reduction, MPV reduction.

UNIT - V Alkaloids, Proteins and nucleic acids

Occurrence, Extraction of alkaloids, Classification of alkaloids, structure elucidation, synthesis and stereochemistry of the following alkaloids: Quinine, Papaverine, Morphine and Reserpine. Biosynthesis of alkaloids.

Classification of proteins; Primary, secondary and tertiary structures of proteins and their functions

Nucleic acids - nucleosides and nucleotides, their chemistry including synthesis; RNA and DNA; Functions of nucleic acids

Text Books:

1. Jerry March, **Advanced Organic Chemistry-Reactions, Mechanisms and Structure**, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, **Organic Chemistry**, Third Edition, McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, **Organic Reactions and Mechanisms**, Second Edition, New Age International Publishers, 2002.
4. I.L. Finar, **Organic Chemistry**, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)
5. G. Chatwal, **Organic Chemistry of Natural Products**, Vol I & II, Himalaya Publishing House, 1988.

Reference Books:

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, **Organic Chemistry,** IV Edn., McGraw Hill Company, 1980.
2. S.M. Mukherji and S. P. Singh, **Reaction Mechanism in Organic Chemistry**, III Edition, Macmillan, 1984.
3. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, Prentice-Hall, VI Edition, 1992
4. Neil Issac, **Physical Organic Chemistry**, J. Wiley, New York, 1987.
5. Paul de Mayo, **Molecular Rearrangements**, Vol I, Vol II, Interscience, NY. 1963.
6. S.W. Pelletier, Van Nostrand, **Chemistry of Alkaloids**, Reinhold, 1970.
7. Hendry, **The Plant Alkaloids**, Churchill Publishers, IV Edn., 1949.
8. Fisher and Fisher, **Steroids,** Reinhold, 1959.

15CYC303 INORGANIC CHEMISTRY PRACTICAL – II

Hours	L	T	P	C
90	4	0	5	3

1. **Complexometric titrations** involving the estimation of Ca, Mg, Ni, Zn and hardness of water.

2. **Quantitative Analysis**

Volumetric and gravimetric estimations of mixtures of cations like copper and nickel, copper and zinc, iron and nickel, iron and zinc, calcium and magnesium.

3. Preparation, Analysis and Study of the Properties of Co-ordination Complexes

Note: Quantitative analysis (involving volumetric and gravimetric estimations) of atleast five mixtures of cations should be done by a student. The volumetric procedure may also include EDTA titrations for the estimation of mixture of cations.

Reference Books

1. J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham, Vogel's text book of quantitative inorganic analysis, ELBS, 1994.

2. W.G. Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold Co., London, 1972.

3. D.N. Grindley, An advanced course in practical Inorganic Chemistry, Butterworths, 1964.

15CYC304 PHYSICAL CHEMISTRY PRACTICAL – II

Hours	L	T	P	C
90	4	0	5	3

Experiments in Electrochemistry, Polarography and Cheimcal Kinetics.

EMF Measurements

1. Determination of standard potentials (Cu and Ag)
2. Determination of thermodynamic quantities from EMF measurements
3. Potentiometric titrations.
4. Determination of pH and calculation of pKa.
5. Determination of stability constant of complex.
6. Determination of solubility product of a sparingly soluble salt, Redox titrations.
7. Precipitation titration of mixture of halides by emf measurements.

DETAILED LIST OF EXPERIMENTS

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. A minimum of 15 experiments have to be performed.

3. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
4. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
5. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
6. Determination of the pH of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
7. Determination of the pH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
8. Determination of the composition and instability constant of a complex by mole ratio method.

9. Calculation of the thermodynamic parameters for the reaction

   i. $Zn + H_2SO_4$ -------> $ZnSO_4 + H_2$ by emf method.

10. Determination of the formation constant of silver ammonia complex and stoichiometry of

the complex potentiometrically.

11. Solubility and solubility products by emf method.

12. Determination of the activity coefficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye - Huckel Limiting law.

13. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$ using Debye- Huckel limiting law.

14. Determination of the electrode potentials of Zn and Ag electrodes in 0.1 M and 0.001M solutions at 298 K and find the standard potentials for these electrodes and test the validity of Nernst equations.

15. Study the inversion of cane sugar in presence of acid using polarimeter.

16. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.

17. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion.)

18. Determination of the viscosities of mixtures of different compositions of liquids and find the composition of a given mixture.

19. Determination of the partial molar volume of glycine/methanol/formic acid/ sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.

20. Study the surface tension – concentration relationship of solutions (Gibb's equation)

Fourth Semester

15CYC401 INORGANIC CHEMISTRY – III

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To study the synthesis, structure, bonding and reactions of metal carbonyls and nitrosyls.
2. To understand the chemistry of metal alkyl, metal allyl, metal alkene, metal alkyne complexes and metal complexes in life processes.

UNIT I

Structure and Bonding

Metal carbonyl complexes - synthesis, structure and reactions; nature of M-CO bonding, binding mode of CO; IR spectra of metal carbonyls, metal carbonyl anions, metal carbonyl hydrides, metal carbonyl halides; metal nitrosyls; dinitrogen complexes; dioxygen complexes, and isolobal relationship.

Alkyl Complexes

Metal alkyl complexes - synthesis by alkylation of metal halides, oxidative addition, and nucleophilic attack on coordinated ligands; Reactivity - M-C bond cleavage reactions, insertion of CO, alkenes and alkynes: insertions of metals with C-H bonds; Alkylidene and alkylidyne complexes - Alkylidene complexes - synthesis in low oxidation and high oxidation states, reactivity and bonding; Alkylidyne complexes – synthesis, reactivity and bonding.

UNIT II

Chemistry of Alkene Complexes

Ligand substitution, reduction and metal atom synthesis; Bonding of alkenes to transition metal complexes; Reactivity - ligand substitution, reactions with nucleophiles - olefin

hydrogenation, hydroformylation, hydrosilation, Wacker process; C-H activation of alkenes – Isomerization; polymerization.

Chemistry of Alkyne Complexes

Synthesis, bonding and reactivity - Cobalt catalyzed alkyne cycloaddition

UNIT III

Allyl complexes – Synthesis, structure and reactivity.

Cyclopentadienyl complexes – Metallocenes – synthesis, bonding and reactions; Cp_2Fe/Cp_2Fe^+ couples in biosensors; **Bent sandwich complexes** - Bonding, metallocene halides and hydrides; metallocene and stereospecific polymerization of 1-alkenes; cyclopentadiene as a non-spectator ligand; **Monocyclopentadienyl (half-sandwich) complexes** - Synthesis and structures.

Arene complexes – Synthesis, structure and reactivity; multidecker complexes.

UNIT IV

Metal complexes in life processes

Metalloporphyrins - the porphyrin ring systems - Chlorophyll, cytochromes; Oxygen carriers - haemoglobin and myoglobin; Ferridoxins and rubredoxins; enzymes; vitamin B_{12} and B_{12} coenzymes - structure and function; synthesis model of enzyme action - Inhibition and poisoning; Nitrogen fixation; Biochemistry of essential and trace elements in biological systems.

UNIT V

Metal complexes in Medicine

Deficiency and disease – Fe, Cu, Zn - Toxic effects of metals – Ca, Fe, Cr, Ni, Cu, Pb, Cd, Hg, Pu. Detoxification by metal chelation. Metals used for diagnosis and chemotherapy – Radiodiagnostic agents (^{57}Co, ^{67}Ga, ^{123}I), MRI, Lithium and mental health, Gold and Rheumatoid Arthritis, Anticancer drugs (Platinum complexes) and their mode of action.

Text Books

1. Bockmann, Organometallics 1, complexes with transition metal-carbon □-bonds, Oxford science publications, Oxford, 1996.

2. Bockmann, Organometallics 2, complexes with transition metal-carbon □-bonds, Oxford science publications, Oxford, 1996.

3. J. Haiduc and J.J. Zuckerman, Basic Organometallic Chemistry, Walter de Gruyter, Brelin, 1985.

4. Organometallic Chemistry, R.C.Mehrotra, A.Singh, New Age International (P) Ltd., 2000.

5. Organometallic Compounds, Indrajit Kumar, Pragati Prakashan, 2008.

6. S.J. Lippard and Berg, Principles of Bioinorganic Chemistry, Univ. Science Books 1994.

Reference Books

1. J. E. Huheey, Inorganic Chemistry – Principles of structure and reactivity, Harper International Edition, Harper and Rone, New York, 1978.

2. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition, 1988.

3. W.L. Jolly, Modern Inorganic Chemistry, McGraw-Hill, 2nd edition, 1991.

4. K.M. Mackey and R.A. Mackey, Introduction to Modern Inorganic Chemistry, Prentice Hall, 4th edition, 1989.

5. F. Basalo and R,G. Pearson, Mechanisms of Inorganic Reactions, Wiley Eastern, 2nd edition, 1977.

6. D.F. Shriver P.W. Atkins and C.H. Long ford, Inorganic Chemistry, ELBS 2nd Edition, 1994.

7. J. A. Cowan, Inorganic biochemistry, Wiley-VCH, New York, 1997.

8. D.E. Fenton, Biocoordination Chemistry, Oxford Science Publication 1995.

15CYC402 PHYSICAL CHEMISTRY - III

Hours	L	T	P	C
72	4	1	0	4

Objectives

1. To understand the basic concepts of electrochemistry
2. To understand the theory of gaseous and colloidal state and to study the properties of gases and colloids.
3. To study the principles and applications of group theory and crystallography.

UNIT-I Electrochemistry -I

Electrolytic conductance–Kohlrausch's law and its applications; ionic equilibria ; conductometric and potentiometric titrations. Debye–Huckel theory- Debye-Huckel-Onsager equation- Debye-Huckel limiting law; Mean ionic activity and activity coefficient- Solubility product -; Nernst equation, redox systems, electrochemical cells-Thermodynamics of electrochemical cells-standard electrode potentials; Applications; corrosion and its prevention-Pourbaix and Evans diagrams ; Batteries-primary and secondary; fuel cells;

UNIT – II Electrochemistry -II

Electrode-electrolyte interface; Interionic attraction; Structures of electrical double layer-Helmholtz-Perrin model-Gouy-Chapman model-Stern model; electrokinetic phenomina; kinetics of electrode reactions; non-equilibrium electrode processes; Electro capillary phenomena – application of diffusion potential; Membrane potential – Polarisation; Over voltage; Butler-Volmer equation; Polarography-principles and applications- concentration polarization – electro chemical polarization;

UNIT-III Gaseous and Colloidal state

Gaseous state-Kinetic theory of gases-Maxwell's distribution of molecular velocities – derivation of expression for average, most probable and root mean square velocities; Colloidal state-preparation methods-Stability; electrical properties of colloids; surfactants-micelles and reverse micelles – Solublization; Emulsification by surfactants;; micro and macroemulsions-gels – importance and application of colloids

UNIT- IV Group theory

Symmetry elements; symmetry operations; point groups - determination; comparison of molecular and crystallographic symmetry; reducible and irreducible representations; direct product representation; orthogonality theorem; character table. - selection rules for IR, Raman and electronic spectra of formaldehyde and ethylene-Hybrid orbitals in non-linear molecules – Examples: H_2O, NH_3, BF_3, CH_4 and XeF_4. Determination of representations of vibrational modes in non-linear molecules such as water, ammonia, BF_3, CH_4 and XeF_4.

UNIT – V Crystallography

Elements of crystallography-laws of crystallography,; crystal systems of lower symmetry and point groups; translational symmetry elements and space groups; Crystal structures; X-Ray diffraction - Bragg's law and applications;.powder method; Neutron and electron diffraction-Principle and applications.

Text Books

1. Allen J. Bard, Larry R. Faulkner, **Electrochemical Methods: Fundamentals and Applications,** John Wiley and Sons, 2nd edition, 2000, ISBN 0-471-04372-9
2. V. Ramakrishnan and M.S. Gopinathan, **Group theory in Chemistry**, Vishal Publications,1988.
3. S.Glasstone, **Introduction to Electrochemistry**, Affiliated East west Press, New Delhi 1960.
4. A.Walton, **Molecular and Crystal Structure Models,** Ellis Horwood, Chichester, 1978.
5. F.C.Phillips, **An Introduction to Crystallography,** John Wiley and Sons, New
6. York, 1963.
7. A.R.West, **Solid State Chemistry and its applications,** John Wiley and Sons, New York, 1984.

Reference Books

1. F.A. Cotton, **Chemical Application of Group Theory**, John Wiley and Sons Inc. New York,1971.
2. K.V. Raman, **Group theory and its applications to Chemistry**, Tata McGraw-Hill Publishing Company,1990.
3. D.R. Crow, **Principles and application of Electrochemistry**, Chapman and Hall, 1991.
4. J.O.M. Bockris and A.K.N. Reddy, **Electrochemistry**, Vols. 1 and 2, Plenum, New York, 1977.
5. P.H.Rieger, **Electrochemistry**, Chapman and Hall, New York, 1994.

15CYC403 SPECTROSCOPY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the theory, principles and applications of various spectroscopic techniques

UNIT I UV-Visible Spectroscopy

Interaction of matter with radiation, Theory of electromagnetic radiation-UV-Visible spectroscopy- Theory & principles of electronic spectroscopy; Types of transitions-solvent effect. Instrumentation and sampling - sample and reference cells, solvents and solutions; Application to inorganic and organic compounds - Woodward-Fischer rules for λ_{max} calculations.

UNIT II IR Spectroscopy

Theory & principles-molecular vibrations, selection rules; coupling, overtones, combination bands; Fermi resonance; Vibration frequencies- factors influencing vibrational frequencies; Instrumentation- Sources, monochromators and detectors-Sampling techniques; FTIR spectra ; Interpretation of IR spectra-Vibrational spectra of polyatomic molecules; Applications to inorganic compounds-Applications to organic molecules-characteristic group frequencies-finger print region.

UNIT III ^{1}H NMR Spectroscopy

^{1}H NMR spectroscopy - theory & principles; instrumentation, Zeeman effect, chemical shift and the factors affecting it. Spin-spin coupling-theory and magnitude of coupling constant. Proton exchange reaction-factors affecting coupling constant; NMR of simple AX and AMX type molecules; Non first order spectra-analysis of complex NMR spectra-simplification- spin decoupling, shift reagents; Double resonance - NMR spectra of solids-magic angle spinning-NMR spectra of paramagnetic compounds-Applications to inorganic ligands and organic molecules.

UNIT IV ^{13}C NMR and Mass Spectroscopy

^{13}C-NMR Spectroscopy**:** Theory and principles - Fourier Transformation; decoupled spectra- ^{1}H decoupling-noise decoupling-broadband decoupling-off resonance-spin tickling; Nuclear Overhauser effect- Structural applications of ^{13}C-NMR. 2D NMR, COSY, ROSY, NOESY ,

CIDNP, INDOR (Basic idea only).

Mass spectra – theory and instrumentation, isotopic abundance-molecular ions-meta stable ions; fragmentation pattern-alkanes, cycloalkanes, alcohols, carbonyl compounds and aromatic hydrocarbons; McLafferty rearrangement-

UNIT IV ESR and Mössbauer Spectroscopy

ESR Spectroscopy-theory and instrumentation- line width, the 'g' values, factors affecting the magnitudes of g and A tensors, zero field splitting and Kramer's degeneracy. Applications of ESR to few biological molecules containing Cu(II), Fe(II) and Fe(III); Jahn-Teller distortions in Cu(II) complexes;

Mössbauer spectroscopy – Theory and principles-Doppler effect, isomer shift, ortho effect-electron-neutron hyperfine interactions, Quadrupole interactions and magnetic interactions; . simple applications of Mossbauer spectroscopy to Iron and Tin compounds.

Text Books

1. R.M Silverstein, C.G. Bassler and Morril, **Spectrometric identification of organic compounds**, VI Edn., John Wiley & Sons, New York, 2002.
2. P.S. Kalsi, **Spectroscopy of organic compounds**, Wiley Eastern Ltd., Madras, 1995.
3. C.F. Banwell, **Fundamentals of Molecular Spectroscopy**, McGraw Hill, New York, 1966.
4. R.S. Drago, **Physical methods in chemistry**, Reinhold, New york,1968.

Reference Books

1. G.M.Barrow, **Introduction to Molecular Spectroscopy**, McGrawHill, NewYork, 1962.
2. J.R.Dyer, **Application of absorption spectroscopy of organic compounds**, Prentice Hall of India Pvt. Ltd., New Delhi, 1974.
3. William Kemp, **Organic Spectroscopy**, ELBS, New Delhi, 1982.
4. A.Carrigton and A.D.McLachlan, **Introduction to Magnetic Resonance**, Harper and Row, New York 1967.
5. William Kemp, **NMR in Chemistry**, MacMillan Ltd., 1986.
6. C.N.R.Rao and J.R.Ferraro, **Spectroscopy in Inorganic Chemistry**, Methven Co., London, 1968.
7. Raymond Chang, **Basic Principles of Spectroscopy,** Mc Graw Hill Ltd., New York, 1993.
8. E.A.V. Ebsworth, D.WH. Rankine and S. Craddock, **Structural methods in Inorganic Chemistry,** Black well Scientific Publ., 1987.

Elective Courses

15CYE01 ANALYTICAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the theory, principles and applications of various analytical techniques
2. To study the theory, principles and applications of various titrimetric Analyses, Complexometric Titrations
3. To understand the basic concepts and applications of computers in chemistry

UNIT I Analytical Data, Treatment and Evaluation

Definition of Term – Mean, Median, Precision and accuracy; Errors in chemical analysis-systematic errors random errors.

Measurement and reporting: Good laboratory practices, calibration of measurements, record management, quality control and control chart.

Treatment of data – Basic statistic concept and frequency distribution, Average and measure of dispersion; Significance of Gaussian distribution curves; Null hypothesis; confidence interval of mean, Criteria for rejection of data; Regression and correlation.

UNIT II Sampling and sample handling

Objectives and sampling – sampling definition, types of sample, sampling plan, quality of sample, sub sampling, sample registration, sample handing, transfer and storage samples.

Microchemical laboratory – Design, safety screen, fume chamber, heating, water supply, drybox/glovebox, Microbalance, quartz balance, fiber microgram balance.

Trace analysis in solution – Nature of trace analysis, scale of working sensitivity, sources of errors; Contamination control in trace analysis.

UNIT III Titrimetric Analysis

Neutralization reactions – theory of acid-base titrations, mono and polyprotic systems, Titration curves and feasibility of reactions, Indicators-theory and choice, calculation of pH during titrations at different stages.

Redox titrations – Redox potentials, theory and feasibility of redox titration, redox indicators, their choice and application.

Precipitation titrations – Theory and types, Volhard, Mohr and Fejan's methods.

UNIT IV Complexometric Titrations

Complexometric titrations – Theory, stepwise and overall formation constants, titration involving monodendate (Cl-) and multidentate ligands (EDTA); Metallochromic indicators – theory and choice; Masking and demasking reagents; Direct, indirect (including substitution) titration and applications.

UNIT V Computer Applications in Chemistry

BASIC constants and variables; BASIC expressions; BASIC statements-Input and Output statements; Transfer and control statements; programming in BASIC only for calculation of equilibrium constants pH of an acidic and basic buffers.

MS-Word, MS-Excel, MS-Power Point and Internet usages in chemistry.

Text Books

1. D.A.Skoog and D.M.West, **Fundamentals of Analytical Chemistry**, Holt Rinehart and Winston Publications, IV Edn, 1982
2. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, **Fundamentals of Analytical Chemistry,** Thomson Asia Pte Ltd., Singapore, Viiith Edn., 2004.
3. D.A. Skoog, **Principles of Instrumental Analysis**, Saunders College Pub.Co, III Edn., 1985.

4. J.G. Dick, **Analytical Chemistry**, McGraw Hill Publishers, 1974.
5. T.S.Ma and V. Horak, **Microscale-Manipulations**, John, Wiley and Sons, 1976.
6. P.C.Jurns, T.L. Isenhour and C.C. Wilkins, **BASIC Programming for Chemists,** JW.& Sons, 1987.
7. K.V. Raman, **Computers in Chemistry,** Tata McGraw Hill, New Delhi, 1993.
8. A.I Vogel, **Text Book of Quantitative Inorganic Analysis,** Pearson V Edn., 2001.

Reference Books

1. Albert Paul Malvino, **BASIC Programming,** PMH Publishers, III Edn., 1984.
2. N.Subramanian, **Programming for BASIC,** A.H. Wheeler and Co. Pvt.Ltd III Edn.,1987
3. Willard, Merit, Dean and Settle, **Instrumental Methods of Analysis,** CBS Publishers and Distributors, IV Edn.,1989
4. G. D. Christian and J.E.O Reilly, **Instrumental Analysis,** Allyn and Bacon Inc, II Edn., 1986.
5. G.W.Ewing, **Instrumental Methods of Chemical Analysis**, McGraw Hill Pub, 1975.
6. A.I Vogel, **Text Book of Quantitative Inorganic Analysis,** ELBS III Edn., 1987.

15CYE02 INSTRUMENTAL METHODS OF ANALYSIS

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the theory, principles (AAS, AES) and applications of various Spectroscopic techniques

Unit I Atomic absorption spectroscopy

Absorption spectroscopy (AAS) – Principles, Elementary theory, instrumentation, Flames, Nebulizer burner system, Non-Flame Techniques, Resonance Line Sources, Detectors, Chemical Interferences, applications and photometric titration.

Atomic Fluorescence spectroscopy (AFS) – Instruments of fluorimetry. Turbidimetry and nephelometry.

Flame photometry – Principles, theory, instrumentation, advantage and disadvantage of flame photometry and a few important applications.

Unit II Atomic emission spectroscopy

Atomic emission spectroscopy (AES)– Principles, Theory, instrumentation, advantage and disadvantage of AES, Origin of Spectra, Measurement of light indensity, applications of emission spectroscopy.

Flame emission spectroscopy (FES) – Principles, instrumentation, Evaluation methods in flame photometry, Factors affecting intensity of emitted radiation, limitation and applications of Flame photometry.

Plasma emission spectroscopy (PES) – Principle, instrumentation, Process of atomization and excitation, Direct Current and inductively coupled plasma, Sample introduction, application, ICP-AES- instrumentation and its applications.

Unit III Photo electron spectroscopy

Photo electron spectroscopy- Principles, theory, instrumentation, types of photo electron spectroscopy, Koopman's Theorem, Chemical Shifts, Core Binding Energy and important applications.

Auger electron spectroscopy - Principles, theory, instrumentation and applications.

Unit IV Polarography and Amperometry

Polarography- Theory, apparatus, DME, diffusion kinetic catalytic currents, current voltage curves for reversible and irreversible system, qualitative and quantitative application to inorganic system.

Amperometric titrations- Theory, apparatus, types of titration curves, successive titrations and two indicator electrodes-applications.

Unit V Chromatography

Gas liquid chromatography (GLC) - Theory and Instrumentation of GLC, Sample injection- Split and splitless injection, Column types, Solid/Liquid Stationary phases, Column switching techniques, Gas chromatographs and chemical analysis, carrier gas. Detectors - Thermal conductivity, flame ionization and electron capture; few applications of GLC.

High Performance Liquid Chromatography (HPLC)- Principles, Theory and instrumentation of HPLC, Optimization of column performance, Gradient elution and related procedures, Derivatization, Mobile phase delivery system, sample injection, column separation and detectors .

Text Books

1. Willard, Merit, Dean and Settle, **Instrumental Methods of Analysis**, CBS Publishers and Distributors, IV Edn. 1986
2. Schoog, Holler, Nieman, **Principles of Instrumental Analysis,** Thomson Asia Pte Ltd., Singapore, 2004.
3. D.A. Skoog, **Principles of Instrumental Analysis,** Saunders College Pub.Co, III Edn., 1985
4. A.I Vogel, **Text Book of Quantitative Inorganic Analysis**, ELBS III Edn, 1987.
5. J.O.M. Bockris and AKN Reddy, **Modern Electrochemistry,** Plenum, 1970.
6. D.A.Skoog and D.M.West **Fundamentals of Analytical Chemistry,** Holt Rinehart and Winston Publications, IV Edn, 2004.
7. W. Kemp, **NMR in Chemistry,** MacMillan Ltd,1986.

Reference Books

1. Albert Paul Malvino **Electronic Principles**, PMH Publishers, III Edn, 1984.
2. J.G. Dick, **Analytical Chemistry,** McGraw Hill Publishers, 1974.
3. G.W.Ewing, **Instrumental Methods of Chemical Analysis,** McGraw Hill Pub, 1975.
4. B. H. Vassos and G.W. Ewing, **Electroanalytical Chemistry,** John Wiley and Sons, NY, 1983
5. R. Greef, R. Peat, L.M. Peter, D. Pletcher and J. Robinson, **Instrumental methods in Electrochemistry**, Ellis Horwood, Chichester, 1985.
6. A.J. Bard and L.R.Faulkner, **Electrochemical methods; Fundamentals and applications,** J. Wiley and Sons, NY, 1980.

15CYE03 ENVIRONMENTAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the fundementals of environmental chemistry

UNIT I Fundamentals

Fundamentals of Environmental Chemistry- Chemical potential, chemical equilibria, acid base reactions and carbonate system, sampling techniques for air, water, and soil.

UNIT II Water Chemistry

Water chemistry- properties of water, nature of metal ions in water, solubility of gases in water, occurrence of chelating agents in water; Redox potential, Significance of redox equilibiria in natural and waste water; microorganisms; The catalyst of aquatic chemical reactions, water pollution and its effects, eutrophication concept of DO, BOD, COD, Sedimentation. Coagulation and filtration.

UNIT III Atmospheric Chemistry

Atmosphere- Nature and composition of atmosphere, chemical and photochemical, reactions in the atmosphere – OZONE and PAN ions and radicals in the atmosphere; gaseous organic and inorganic pollutions in the atmosphere; Global warming and effects of CO, SO_2, NO_x.

UNIT IV Soil Chemistry

Soil chemistry- inorganic and organic components of soil, Nitrogen pathways. NPK in soils; Toxic chemicals in the environment pesticides and their toxicity; biochemical aspects of arsenic, cadmium, lead & mercury.

UNIT V Wastes

Environmental chemistry of hazardous wastes, hazardous wastes in hydrosphere, geosphere and atmosphere, industrial production of hazardous wastes; Health effects of hazardous wastes.

Text Books

1. Sharma and Kaur, **Environmental Chemistry,** Krishna Publishers, New Delhi, 2000.

2. A.K. De, **Environmental Chemistry**, Wiley Eastern Ltd, New Delhi, 1989.

Reference Books

1. J.Rose Gordon and Breach (Ed.), **Environmental Toxicology**, Science Publication, New York, 1993.

2. S.Ladsberger and Creatchman (Ed.), **Elemental Analysis of Airborne Particles**, Gordon and Breach Science Publication New York, 1998.

3. S.E Manahan, **Environmental Chemistry**, Lewis Publishers, London, 2001.

4. S.M. Khopkar, **Environmental Pollution analysis**, Wiley Eastern, New Delhi, 1994.

5. S.K. Banerji, **Environmental Chemistry**, Prentice Hall of India, New Delhi, 2003.

15CYE04 POLYMER CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the preparation, characterizations and applications of various types of polymers

UNIT I Basic Concepts

Basic concepts: Monomers, repeat units degree of polymerization, linear, branched and network polymers. Condensation polymerization: Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization: Free radicals, cationic and anionic polymerization. Polymerization conditions. Polymerization in homogeneous and heterogeneous systems.

UNIT II Coordination and Copolymers

Coordination Polymerization: Kinetics, mono and bimetallic mechanism of copolymers. Copolymerization: Block and graft copolymers, kinetics of copolymerization. Evaluation of monomer. Reactivity ratio. Rate of copolymerization.

UNIT III Molecular Weight

Molecular weight and properties of polymers; Polydispersion-average molecular weight concept, number weight and viscosity average molecular weights. Measurement of molecular weights. Gel permeation chromatography, viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer structure and physical properties –crystalline melting point T_m. The glass transition temperature. Determination of T_g. Relationship between T_m and T_g.

UNIT IV Processing

Polymer Processing: Plastics elastomers and fibres. Compounding processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT V Commercial Polymers

Properties of Commercial Polymers: Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers-Fire retarding polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Text Books

1. F.W.Billmeyer, **Text Book of Polymer Science**, 3rd Edn., John Wiley & Sons, New York, 2003.
2. V.R.Gowarker, N.V.Viswanathan and J. Sreedhar, **Polymer Science**, New Age International, New Delhi, 2003.

Reference Books

1. H.R.Alcock and F.W.Lamber, **Contemporary Polymer Chemistry**, Prentice Hall,1981.
2. P.J.Flory, **Principles of polymer chemistry**, Cornell University press, Newe York, 1953.
3. G.Odian, **Principles of polymerization**, 2nd Edn., John Wiley & Sons, New York,1981.

15CYE05 CHEMISTRY OF NANOMATERIALS

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand synthesis, characterization, properties and applications of various nanostructures

UNIT I Structure and properties of metals and alloys

Crystal structure of metals and alloys, intermetallic compounds, interstitial compounds, electronic compounds; electrical and magnetic properties of metals-resistivity, magnetoresistance, de Hass Van Alphen effect, cyclotron resonance, hall effect, thermoelectric power, superconductivity, diamagnetism, ferromagnetism, anti-ferromagnetism, Pauli paramagnetism, Einstein de Hass effect, magnetic resonance spectroscopy.

UNIT II Solid Electrolytes, Semiconductors and Super Conductors

Semiconductors- properties, semiconductor and metal electrodes, semiconductor-electrolyte interface, semiconductor – electrolyte junction, space charge layer, depletion layer, Helmholtz and Gouy layer and flat band potential; Solid electrolytes – Ag^+ conductors, Li^+ conductors, Cu^+ conductors, F^- conductors, O_2^{2-} conductors, beta-alumina and other conductors; applications of solid electrolytes; super conductors-super conducting materials and compounds, magnetic properties, heat capacity, energy gap, MW and IR properties, super conducting magnets, high T_c superconductors; characterization.

UNIT III Photoconductors, Photovoltaics, Solar Cells and Solar Coatings

Photocells-photoemissive, photo conductive and photovoltaic cells; photo conductive effect, photo current, photo conductivity, speed of response, photosensitivity, preparation of photoconductors and photovoltaic effect; photoelectrochemical cells, photoelectrolytic cells; Applications. Solar coatings-solar foils, black chrome, black nickel, black alumina, black zinc, black copper, blackened steel, blackened SS and black cobalt.

UNIT IV Oxide Films, Thin Films and Membranes

Growth of oxide films-barrier oxide layer, composition, structure and physical properties; Thin films-various stages of film growth, defects during growth, grain boundaries, surface area and

roughness; techniques of film growth- PVD, CVD, CSVT, sputtering and plasma deposition. Membranes-types of diaphragm and membrane materials; Preparation of membranes-physical methods, Leach or Cook out method, gelatin process; Applications

UNIT V Luminescent Materials and Conducting Polymers

Luminescence - photoluminescence, electroluminescence and cathadoluminescence; Fluorescent phosphors-Calcium tungstate phosphor, Zinc silicate green phosphor, Magnesium fluogermanate red phosphor and Calcium halophosphate day light phosphor

Conducting polymers-intrinsically conducting polymers, extrinsically conducting polymers, non-bridged polymers and chain bridged polymers; Synthetic methods; methods of doping-simple chemical doping, electrochemical doping and photochemical doping.

Text Books

1. V.A. Myamlin and Y.V. Pleskov, **Electrochemistry of semiconductors**, Plenum press, New York, 1979.
2. J.M.Blatt, **Theory of super conductivity**, Academic press, 1964.
3. K.L. Chopra, **Thin films**, Mc.Graw Hill Book Co.,1982.
4. V.Ragavan, **Materials Science and Engineering, First Course**, 2nd Edn., Prentice-Hall India, 1985.
5. N. Cusack, **Electrical and magnetic properties of solids**, Langmans, 1958.

Reference Books

1. E.C.Subba Rao, **Solid electrolytes and their applications**, Plenum Press, 1980.
2. H.J. Hovel, **Semiconductors and semiconducting materials Vol.2. Solar cells**, Academic press, 1975.
3. R.H. Bube, **Photoconductivity of solar cells**, John Wiley & sons. Inc.,1967.
4. D. Curie, **Luminescence in crystals**, John Wiley & Sons, Inc., New York, 1963.
5. A.Skothem (Ed.), **Hand book of conducting polymers** – Vol. I and II, Marcel Dekkar, 1986.

15CYE06 MEDICINAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the basic concepts of medicinal chemistry
2. To understand the structure activity relationships of selected drug molecules

Unit I Basic Concepts

Drug design - analogues and pro-drugs, factors governing drug design, rational approach,method of variation and tailoring of drugs; Physical properties-factors governing drug action at active site, factors governing ability of drugs to reach active site, dissociation constants, isosterism and bioisosterism; general anaesthetics-inhalation anaesthetics, intravenous anaesthetics and basal anaesthetics;mode of action; local anaesthetics-classification and syntheses, sedatives and hypnotics-classification, synthesis, mode of action and structure-activity relationship.

Unit II Anticonvulsants, Stimulants and Antipyretic Analgesics

Anticonvulsants - classification, synthesis and mode of action; Muscle relaxants-classification, synthesis and mode of action. Central nervous system stimulants- classification, synthesis and mode of action; Antipyretic analgesics- classification, synthesis and mode of action;

Unit III Other Analgesics

Narcotic or Opiate analgesics - classification, preparation and mode of action; Narcotic antagonists; Cardiovascular drugs-classification, synthesis and mode of action; Autonomic drugs-synthesis and mode of action of sympathomimetic drugs, antiadrenergic drugs, cholinomimetic drugs, antimuscarinic drugs, ganglionic blocking agents and adrenergic neurone blocking agents; Diuretics - synthesis and mode of action of mercurial and non-mercurial diuretics.

Unit IV Antihistamines, Anti-inflammatory and Antiparkinson drugs

Antihistaminics - synthesis and mode of action of histamine H_1 receptor antagonists and histamine H_2-receptor blockers; prevention of histamine release; structure-activity relationships amongst H_1-receptor blockers. Non-steroidal anti-inflammatory drugs(NSAID)-synthesis and mode of action of heteroarylacetic acid analogues, arylacetic acid analogues, arylpropionic acid analogues, naphthalene acetic acid analogues, gold compounds, salicylic acid analogues and pyrazolones and pyrazolodiones; Antiparkinsonism agents-synthesis and mode of action of piperidine analogues, pyrolidine analogues and phenothiazine analogues.

Unit V Other drugs

Expectorants and antitussives-synthesis and mode of action of sedative expectorants, stimulant expectorants and centrally acting antitussive agents. Sulphonamides-preparation and mode of action of sulphonamides for general, urinary, intestinal and local infection; sulphonamide inhibition. Antimalarials-synthesis and mode of action of aminoquinoline analogues, aminoacridine analogues, guanidine analogues, pyrimidine analogues, sulfone and quinine analogues; Steroids-synthesis and mode of action of sterols, sex harmones, cardiac glycosides, bile acids and sapogenins. Antibiotics-synthesis and mode of action of penicillins, aminoglycoside antibiotics, chloramphenicol and tetracyclines.

Text Books

1. Ashutosh Kar, **Medicinal Chemistry**, New Age International, 1996.
2. W.O.Foye, **Principles of medicinal chemistry**, 2nd edn., Lea & Febiger, Philadelphia, 1981.

Reference Books

1. M.E.Wolff, **Burger's medicinal chemistry**, 4th Edn., John Wiley &Sons, New York, 1981.
2. F.F.Blicke and R.H.Cox, **Medicinal Chemistry**, John Wiley &Sons, New York, 1959.
3. D.Lednicer and L.A.Mitscher, **Organic Chemistry of drug synthesis**, John Wiley & Sons, New York, 1959.
4. J.E.Hoover, **Remington's Pharmaceutical sciences**, 15th Edn. Mack Publ.Company, Easton, 1975.

15CYE07 DYE CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the structures, synthesis and applications of various types of dyes

Unit I Introduction

Colour and chemical constitution - chromophore, auxochrome and resonance, various theories; History of natural and synthetic dyes; Names of commercial dyes; Study of raw materials and dyestuff intermediates; Unit operations - nitration, sulphonation, halogenation, amination, diazotisation and alkali fusion; Colour index and its significance; Classification of dyes based on chemical constitution and method of applications; General properties - linearity, coplanarity and fastness.

Unit II Direct, Acid and Basic Dyes

Direct cotton dyes (substantive dyes) – Classification, properties, structure and mechanism of dyeing, post treatment of dyeing; Acid dyes and Basic dyes – Classification, Characteristics, trade names, Mechanism of dyeing, Nature of affinity on cellulose and protein fibres.

Unit III Mordant, Azo and Vat Dyes

Mordant dyes – classification, methods of application; Metal complex dyes – types of bond formation between dye and various fibres; Azo dyes – Azoic coupling components, protective colloids, electrolytes, stabilisation of diazonium salts, principles and application; Vat dyes and solubilised vat dyes – classification, methods of application, trade names, principles and application, Stripping agents and correction of faulty dyeing.

Unit IV Other Dyes

Chemistry involved in the production of Aniline black; Prussian black; Sulphur colours; phthalocyanines; Disperse dyes - classification based on chemical structure, properties and principles of application; Solvent soluble dyes - Nigrosines and Indulines; Cyanine dyes.

Unit V Colour and Brightening

Fluorescent brightening agents (FBA) - Theory and applications; Identification and estimation of dyes on fibres; The action of light on dyes and dyed fibres; Mechanism of fading.

Text Books:

1. K. Venkataraman, **The chemistry of synthetic dyes** Part I & II, Academic Press, New York, 1952.
2. V. A. Shenai, **Introduction to Chemistry of Dyesuffs**, Sevak Prakashan Pub., Mumbai, 1991.

Reference books

1. V. A. Shenai, **Chemistry of Dyes and Principles of Dyeing** Vol.-II, Sevak Prakashan, Mumbai, 1987.
2. V. A. Shenai, **Ecology and Textiles**, Sevak Publications, Mumbai, 1997.
3. D. M. Nunn, **The Dyeing of Synthetic Polymer and Acetate Fibres**, Dyers Company, Publication Trust, 1979.
4. V. A. Shenai, **Toxicity of Dyes and Intermediates**, Sevak Publications, Mumbai, 1998.
5. **Directory of safe dyes conforming to German Consumer Goods Ordinances**, The Dyestuff Manufacturers Association of India, 1996.

15CYE08 CHEMISTRY OF WATER TREATMENT

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand water pollution and treatment techniques for water purification

Unit I Introduction

Sources of Water; Physical and chemical characteristics of water; Water analysis; Potable water – WTO standard: uses of water

Unit II Water Pollution

Water pollution – wastewater generation - classification of water pollutants; constituents and characteristics of wastewater; measurement techniques – sampling, colour & odour, dissolved oxygen, BOD, COD, TOC, N & P, suspended solids and bacteriological measurements.

Unit III Wastewater Treatment

Wastewater treatment: Pretreatment – screening, grit removal and pre-chlorination; Primary treatment – settling and sedimentation; Secondary treatment – trickling filter process, activated sludge process; Aeration.

Unit IV Industrial Wastewater Treatment

Industrial wastewater treatment: Activated sludge treatment plants – mass balances, with and without recycle plants; Types of plants – single tank, contact stabilization, biosorption plants. Biofilters: Hydraulic film diffusion, two component diffusion; Types of plants – trickling filters, submerged filters and rotating disc; removal of particulate organic matter.

Unit V Treatment Plants

Treatment plants for nitrification – mass balances, nitrifying plants and types of plants. Treatment plant for denitrification - mass balances, denitrifying plants and types of plants; redox zones in the biomass.

Anaerobic wastewater treatment: Plant types – pretreatment, plant with suspended sludge and filter process.

Text books

1. A.K.De, **Environmental Chemistry**, Wiley Eastern, 1989.
2. S.K.Banerji, **Environmental Chemisty**, Prentice Hall of India, New Delhi, 2003.

Reference books

1. L.Winther, **Wastewater Engineering**, Polyteknisk Forlag, Lyngby, 1978.
2. M.Henze, P.Harremoes, J.C.Jansen and E.Arvin, (Ed.), **Wastewater treatment**, Springer Verlag, New York, 1995.
3. P.Harremoes, **Water Chemistry**, Polyteknisk Forlag, Lyngby, 1989.

15CYE09 GREEN CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the theory, principles and applications of green chemistry

Unit I Introduction

The need for green chemistry – Twelve principles – Atom economy – Scope for green chemistry – Inception and awards.

Unit II Solvent free reactions

Exploration of solvent free reactions – Microwave assisted organic synthesis – Functional group transformations – Protection and deprotection reactions, Condensation reactions, reduction and oxidation.

Ionic liquids – Synthesis of ionic liquids – Applications in organic synthesis.

Unit III Eco-friendly green Techniques

Biocatalysts – Modified biocatalysts – Transition metal catalysts – Supported metal catalysts.

Eco-friendly synthesis and reactions of , -unsaturated nitroalkanes.

Heterogenised reactions – Mineral solid catalysed reactions – Solid supported catalysts – Super critical fluids.

Unit IV Alternative Treatment Technologies

Oxidation at ambient conditions for wastewater treatment – Photocatalytic reactions – Electrocatalytic reactions – Fentons chemistry – Hybrid processes.

Chemical methods for dye removal – Oxidative processes – physical treatments – Biological treatments.

Unit V Exploration of Green Chemistry

Trace element speciation by hyphenated techniques – tools for analytical speciation.

Green chemicals – Prospects and future in designing new drugs. Designing of next generation agrochemicals from nature.

REFERENCE BOOKS:

1. Rashmi Sanghi and M.M.Srivastava (Eds.), **Green Chemistry – Environment friendly alternatives**, Narosa Publishing house, New Delhi, 2003.
2. P.T.Anastas and J.C.Warner, **Green Chemistry: Theory and Practice**, Oxford Science Publications, Oxford, 1998.
3. P.Tundo and P.T.Anastas(Eds.) **Green Chemistry: Challenging Perspectives**, Oxford University Press, Oxford, 2000.
4. P.T.Anastas and T.C.Williamson(Eds.) **Green Chemistry: Frontiers in Chemical Synthesis and processes**, Oxford University Press, Oxford, 1985.
5. A.S.Matlach, **Introduction to Green Chemistry**, Marcel Decker Inc.. New York, 2001.

15CYE10 MEDICINAL INORGANIC CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

Objectives

1. To understand the importance of inorganic compounds in medicinal chemistry

Unit-I

Essential and Ttrace Elements in Biological Systems:

structure and functions, metal deficiency and disease; toxicity of mercury, cadmium, lead, beryllium, selenium and arsenic, chelation therapy: metals used for diagnosis and chemotherapy, crown ether complexes of Na+ and K+; ATP and ADP.

Co-ordination Compounds and Complexation:

Theoretical considerations and official products: Calcium disodium edetate, Disodium edetate, Dimercaprol & Penicillamine; Platinum complexes as anticancer drugs, Pt-DNA binding, complexes of gold, copper, zinc, mercury, arsenic and antimony as drugs.

Unit-II Topical Agents

Protectives: Calamine, Talc, Zinc Oxide, Zinc Stearate, Titanium dioxide, Silicon Polymers and Dimethicone.

Astringents: Zinc sulphate, Alum.

Anti-infectives: Boric acid, Hydrogen peroxide, Iodine, Potassium permanganate, Chlorinated Lime.

Dental Products

Anti-caries Agents: Role of Fluorides as anti-caries agents, Sodium fluoride*.

Dentifrices: Calcium carbonate, dibasic calcium phosphate, Zinc chloride.

Unit III Gastro-intestinal agents.

Acidifiers and Antacids: Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate, aluminium hydroxide gel, dried aluminium hydroxide gel, magnesium oxide (Magnesia), magnesium hydroxide mixture, magnesium trisilicate.

Adsorbents and related drugs: Light kaolin, heavy kaolin, and activated charcoal.

Laxatives: Magnesium sulphate, sodium phosphate.

Mineral Nutrients / Supplements

(a) **Haematinics** – Ferrous sulphate, ferrous fumarate, ferrous gluconate, ferric ammonium citrate, iron and dextrose injection.

(b) **Halogens:** Iodine, Iodides.

Pharmaceutical aids:

(a) **Excipients**: Dicalcium phosphate, magnesium stearate, talc and calcium carbonate (Precipitated chalk).

(b) **Suspending agents**: Bentonite, colloidal silica.

(c) **Colorants:** Titanium oxide, Ferric oxide

Unit-IV Electrolytes:

Major intra and extra cellular electrolytes:

Physiological role of Chloride, Phosphate, Bicarbonate, Sodium, Potassium, Calcium and Magnesium; **Electrolytes used for replacement therapy**: Sodium chloride, Potassium chloride, Calcium chloride, Calcium lactate, Tribasic calcium phosphate; Physiological acid-base balance: Sodium dihydrogen phosphate, Sodium acetate, Sodium bicarbonate and their importance; **Electrolytes used in the acid-base therapy:** Sodium acetate, Potassium acetate, Sodium citrate, Potassium citrate, Sodium lactate, Ammonium chloride; **Electrolyte combination therapy:** Compound sodium chloride solution, Sodium chloride injection and Oral rehydration salt (ORS); **Dialysis fluids:** Haemodialysis fluids.

Unit-V

Inorganic Radio-Pharmaceuticals:

Radioactivity, Units of radioactivity, radiation dosimetry, Measurement of radioactivity, Hazards and precautions in handling of radiopharmaceuticals, storage, radio pharmaceutical preparations and standards of radioactive material iodine-131 (I131), Cobalt -58 (Co58). Radio opaque contrast medium-barium sulphate.

Miscellaneous Inorganic Pharmaceutical Agents: Inhalants, respiratory stimulants, expectorants and emetics, antidotes, tableting aids and suspending agents.

Text Books

1. L.M. Artherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry, 8th edition, Oxford University Press, New Delhi, 2003.
2. J.H. Block, E. Roche, T.O. Soine & C.O. Wilson, Inorganic Medicinal & Pharmaceutical Chemistry. 1st edition, Varghese publishing house, Mumbai, 1986.
3. K.S. Rao and C.V. Suresh, "Pharmaceutical Inorganic Chemistry", PharmaMed Press, 2011.
4. A.V. Kasture, S.G. Wadodkar, Pharmaceutical Chemistry-I, Nirali Prkashan, 25th edition, 2008.
5. V. N. Rajasekaran, Text Book of Pharmaceutical Inorganic Chemistry Theory and Practical, 2nd edition, Sun Publication, Chennai, 2005.
6. J. Ghosh, A Textbook of Pharmaceutical Chemistry, S.Chand, 3rd edition, 2003.

Reference Books

1. Chatwal, Pharmaceutical Chemistry Inorganic. 3rd edition, Himalaya publishing house, Mumbai, 2007.
2. T.O.Soine and C.O.Wilson, Roger's Inorganic Pharmaceutical Chemistry, 4th edition, Lea & Febiger, Philadelphia, 1948.

3. G.L. Miessler, and D.A. Tarr, Inorganic Chemistry, Pearson Education, 2005.

4. S.J. Lippard and Berg, Principles of Bioinorganic Chemistry, Univ. Science Books 1994.

5. J. A. Cowan, Inorganic biochemistry, Wiley-VCH, New York, 1997.

6. N.V. Chenchu Lakshmi, “Pharmaceutical Inorganic Chemistry: Theory and Practice”, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

15CYS01 FUNDAMENTAL ASPECTS OF ELECTROANLAYTICAL TECHNIQUES

Hours	L	T	P	C
72	4	0	0	4

UNIT I Basic Electrochemical principles

Mass transfer processes – migration, diffusion and convection– planar and spherical diffusion – Reversible and Irreversible processes.

UNIT II Methods Based on Diffusion

Principle, instrumentation and applications of the following techniques: Chronoamperometry; Polarography - Ilkovic equation - Square wave polarography; Linear Sweep voltammetry – Randles Sevrik equation; Cyclic voltammetry - Normal pulse, Differential pulse and Squarewave voltammetry.

UNIT III Coulometric and Potentiometric Methods

Galvanostatic and potentiostatic methods. Principle, instrumentation and applications of the following techniques: Controlled potential coulometry and electrolysis; Chronocoulometry; Potentiometry and Chronopotentiometry.

UNIT IV Stripping voltammetry

Principle, instrumentation and applications of Anodic stripping voltammetry, Cathodic stripping voltammetry and Adsorptive stripping voltammetry.

UNIT V Sine wave methods (Electrochemical Impedance Spectroscopy)

Principle of Impedance technique - Analysis of Faradaic impedance – Bode Diagrams. Dynamic electrode techniques**,** Principle, instrumentation and applications of RDE and RRDE techniques.

Text Books

1. D.A.Skoog and D.M.West, **Fundamentals of Analytical Chemistry,** Holt Rinehart and Winston Publications, IV Edn, 1982.
2. Willard, Merit, Dean and Settle, **Instrumental Methods of Analysis,** CBS Publishers and Distributors, IV Edn. 1986

Reference Books

1. B. H. Vassos and G.W. Ewing, **Electroanalytical Chemistry,** John Wiley and Sons, NY, 1983.

2. A. J. Bard and L.R. Faulkner, **Electrochemical methods; Fundamentals and applications,** J. Wiley and Sons, NY, 1980,
3. J.Wang, **Stripping Analysis,** VCH Publications, 1985.
4. A.M. Bond, **Modern Polarographic methods in analytical chemistry,** Macel Decker Inc., 1980.

15CYS02 CONDUCTING POLYMERS

Hours	L	T	P	C
72	4	0	0	4

UNIT – I Basic Concepts and Synthetic methods

Basics of conducting polymers - Organic - conjugated unsaturated hydrocarbons- Chemical Synthesis of conducting polymers – Other synthetic methods

UNIT – II Electrochemical Synthesis

Electrochemical synthesis of conducting polymers – monomers, electrolytic condition, electrodes and mechanism; Electrochemical synthesis of derivatives of poly pyrrole, polythiophene, polyazulene, polycarbazole, polyindole, polyaniline and polyphenylene.

UNIT – III Semiconducting and Metallic Polymers

Structural basis for semiconducting and metallic polymers – introduction; Organic meta polymers - Synthetic route, isomers and electronic structure (polymers like polyacetylene, poly(p-phenylene), polypyrrole, polythiophene, etc.,).

UNIT – IV Doping

Electrochemical doping; deadline to the development of conducting polymers; role of reduction and oxidation potential in doping; polyacetylene as electrode materials.

UNIT – V Catalytic Conducting Polymers

Catalytic properties of conducting polymers; catalysis of electron donor-acceptor complexes; electrocatalysis by semiconducting polymers.

Text Books

1) Terje A. Skotheim, Ronald L. Elsenbaumer, John R. Reynolds, **Handbook of Conducting Polymers,**

Second Edition, Marcel Dekkar, 1995.

2) Hari Singh Nalwa (Edn), **Handbook of Organic Conductive Molecules and Polymers,** Four Volumes, Wiley, 1997

Reference Books

1) Jean-Pierre Farges, **Organic Conductors**, Marcel Dekkar, 1994
2) David B Cotts, Z Reyes, **Electrically Conductive Organic Polymers for Advanced Applications**, William Andrew Inc,1987
3) Larry Rupprecht, **Conductive Polymers and Plastics,** William Andrew Inc, 1999.
4) Raymond B Seymour, **New Concepts in Polymer Science, Polymeric Composites**, VSP, 1990.
5) Wallace Gordon, Gordon G Wallace, Geoffrey M Spinks, **Conductive Electroactive Polymers,** CRC Press, 2002

15CYS03 INDUSTRIAL AND AGRICULTURAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

UNIT-I Water, Fuels and Industrial Gases

Water - Treatment for domestic and industrial purpose; Fuels- Calorific value, requirement of a fuel, types, refining crude petroleum, octane number, anti-knocking compound; Industrial gases-Manufacture and industrial applications of coal gas, producer gas, water gas, semi-water gas and LPG.

UNIT-II Irrigation

Crop seasons - seeds, seed development organization, natural seeds project phase-III, new policy on seed development; Soil- soil reclamation, alkali soil, saline soils, methods for soil reclamation; Irrigation- Environmental degradation and irrigation projects.

UNIT-III Conservation and Fertilizers

Soil and water conservation - plant protection; integrated pest management; Technology mission on oil seeds and pulses; Fertilizers; Effect of nitrogen, potassium and phosphorous on plant growth. Manufacture and composition of urea, triple super phosphate, complex fertilizers, mixed fertilizers and biofertilizers; secondary nutrients and micro nutrients-their function in plants.

UNIT-IV Pesticides and Insecticides

Pesticides - classification, organic, inorganic and general; methods of application and toxicity; safety measures in using pesticides; Insecticides: plant products-nicotine and pyrithrin; Inorganic pesticides-borates; organic pesticides-DDT and BHC

UNIT-V Fungicides and Herbicides

Fungicides - sulfur compounds, copper compounds and boredeaux mixture; Herbicides-Acaricides, Rodenticides, Attractants; Repellents; Preservation of seeds

Text Books

1. B.K.Sharma, **Industrial Chemistry**, Goel Publishing House, Meerut,1992.
2. N.C. Brady, **The nature and properties of soils**, Eurasia Publishing House, New Delhi, 1977.
3. G.N. Pandey, **A Textbook of Chemical Technology, Vol. I & II,** Vikas Publishing House Pvt Ltd, 1997.

Reference Books

1. B.N.Chakrabarthy, **Industrial Chemistry**, Oxford and IBH, New Delhi, 1981.
2. P.P. Singh and T.M. Joseph, **College Industrial Chemistry**, Himalaya Publishing House, Bombay, 1987.
3. V.S. Jones, **Fertilizers and soil fertility**, Prentice Hall of India, New Delhi,1993.
4. D.E.H. Freer, **Chemistry of pesticides**, D.Van Nostrand Co, Reinhold,1969.

15CYS04 CHEMISTRY OF NATURAL PRODUCTS

Hours	L	T	P	C
72	4	0	0	4

UNIT I Carbohydrates

Introduction, definition and classification; Monosaccharides – configuration of aldotrioses, aldotetroses, aldopentoses, aldohexoses, Ketohexoses; Deoxy-sugars; Ring structure of monosaccharides; mutarotation; a brief introduction on the structure of disaccharides (sucrose and maltose as representative examples) and polysaccharides (starch, cellulose and cyclodextrins as representative examples).

UNIT II Terpenoids

Classification; Isoprene rule; Monoterpenoids – structure elucidation and total synthesis of citral, □– terpineol and □ – pinene.

UNIT III Carotenoids

Introduction – carotenes, xanthophylls, apocarotenoids, epipasic carotenoids and hypophasic carotenoids; Structure elucidation and total synthesis of □ – carotene and vitamin – A.

UNIT IV Steroids

Classification with examples; nomenclature of steroids; Structure of Cholesterol; Structure of bile acids.

UNIT V Alkaloids

Definition; Occurrence; Extraction of alkaloids; General properties; Classification of alkaloids; Structure elucidation and synthesis of piperine and nicotine.

Text Books

1. I.L. Finar**, Organic Chemistry, Vol.II**, 5th Edn. Pearson Education Asia Pvt. Ltd. 2000
2. Atta-Ur-Rahman and M.I.Choudhary, **New Trends in Natural Product Chemistry,** Gordon & Breach Science Publishers, I Edn., 1998.
3. Pinder, **The Chemistry of Terpenes,** Chapman and Hall, 1960.
4. Bentley, **The Natural Pigments,** Interscience, 1960

5. Fisher and Fisher, **Steroids,** Reinhold, 1959.

Reference Books

1. S.W. Pelletier,Van Nostrand, **Chemistry of Alkaloids,** Reinhold, 1970.
2. A.A. Newman (Ed.), **Chemistry of Terpenes and Terpenoids**, Academic Press, London, 1972.
3. Hendry, **The Plant Alkaloids**, Churchill Publishers, IV Edn., 1949
4. Templeton, **An Introduction to the Chemistry of Terpenoids and Steroids**, Butterworths, 1969.

15CYS05 CHEMISTRY OF INDUSTRIAL PRODUCTS

Hours	L	T	P	C
72	4	0	0	4

UNIT I Glass

Glass - Introduction, raw material, steps involved for manufacture of glass, some special glasses, fused silica glasses, high silica, optical glasses, coloured glasses, opal glasses, safety glasses, bottle glasses.

UNIT II Cement

Cement - Introduction, types of cement, types of Portland cement, raw materials, quantitative requirements, setting of cement, factors affecting quality of cement.

UNIT III Dyes

Dyes - Sensation of colour, classification of dyes, acid dyes, basic dyes, direct dyes, mordant dyes, vat dyes, ingrain dyes, food dyes, application of dyes for cotton fabric.

UNIT IV Pigments and Paints

Pigments - white pigment, white lead, blue pigment, ultramarine blue, red pigment, red lead, green pigments, Chrome green.

Paints - constitutions of paint, requirement of a good paint, paint failure.

UNIT V Fertilizers

Fertilizers - Plant nutrients, need for fertilizers requirement, classification of fertilizers, natural fertilizers, artificial fertilizers, phosphate fertilizers.

Text Books

1. B.K. Sharma, **Industrial Chemistry,** Goel Publishing House Pvt Ltd, 1999.
2. M.G. Arora and M. Singh, **Industrial Chemistry,** Anmol Publications, 1st edition, 1994.
3. G.N. Pandey, **A Textbook of Chemical Technology, Vol. I & II,** Vikas Publishing House Pvt Ltd, 1997.

Reference Books

1. B.N. Chakrabarty, **Industrial Chemistry,** Oxford & IBH Publishing Co. Pvt Ltd, 1991
2. V. Subrahmaniyan, S. Renganathan, K. Ganesan, S. Ganesh, **Applied Chemistry,** Scitech Publications, 1998.
3. J.E. Kuria Cose and J. Rajaram, **Chemistry in Engineering & Technology, Vol. I & II,** Tata Mc Graw Hill, 1984.

15CYS06 FUNDAMENTALS OF ANALYTICAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

UNIT I Analytical Data Treatment and Evaluation

Definition of Terms – Mean, Median, Precision, accuracy. Errors in chemical analysis-systematic errors and random errors.

Treatment of data - Basic statistical concept - Frequency distribution, Average and measure of dispersion, Significance of Gaussian distribution curves, confidence interval of mean, Criteria for rejection of data. Regression and correlation, quality control and control chart.

UNIT II Sampling

Preparing the sample for analysis - The effect of sampling uncertainities, gross sample, determination of the size of the sample, analytical sample.

Sampling of solids - Preparation of laboratory sample from gross sample, moisture in the sample, sampling of gases and liquids.

UNIT III Titrimetric Analysis :

Neutralization reactions – theory of acid-base titrations, Tirtration curves and feasibility of reactions, Indicators-theory and choice, calculation of pH during titrations.

Redox titrations – Redox potentials, theory and feasibility of redox titrations, redox indicators, their choice and application.

Precipitation titrations – Theory and types, Volhard, Mohr and Fejan's methods.

UNIT IV Analysis of Industrial samples -I

Ore and cement analysis – Oxides, sulphides and carbonate ores, one example each. Cement, silicate and glass.

Liquid fuels – Flash point, viscosity, carbon residue aniline point, pour point.

UNIT V Analysis of Industrial samples -II

Gaseous fuels – sampling procedure, ultimate and proximate analysis, specific volatile index, ash content, calorific value by bomb colorimeter, and Junker's calorimeter.

Water analysis – BOD, COD and hardness of water.

Text Books

1. D.A.Skoog and D.M.West, **Fundamentals of Analytical Chemistry,** Holt Rinehart and
2. Winston Publications, IV Edn,, 1982.
3. A.I Vogel, **Text Book of Quantitative Inorganic Analysis,** ELBS III Edn, 1987.

4. A.I Vogel, **Text Book of Quantitative Inorganic Analysis,** Pearson V Edn 2001.
5. J.G. Dick, **Analytical Chemistry**, McGraw Hill Publishers, 1974.
6. T.S.Ma and V. Horak, **Microscale-Manipulations**, John Wiley and Sons, 1976.

Reference Books

1 . D.A. Skoog, D.M.West, F.J. Holler and S.R.Crouch, **Fundamentals of Analytical Chemistry**, VIII Edn., Thomson Brooks/Cole Publishers, 2004.

2. H.A. Stobel Addison, **Chemical Instrumentation,** Wesley Publishers Co., 1976.

15CYS07 PHARMACEUTICAL CHEMISTRY

Hours	L	T	P	C
72	4	0	0	4

UNIT I Introduction

Important terminologies - pharmaceuticals, drugs, pharmacodynamics, Pharmacokinetics, pharmacopoea, virus, bacteria, fungus, actinomycetes, metabolites, antimetabolites ,LD50 and ED50; Therapeutic index- their use in selecting drugs; assay of drugs; Use of plaster of paris in bone – fracture;

UNIT II Antibiotics, Sulpha drugs and Vitamins

Antibiotics-synthesis, assay and structure and uses of penicilline, chloramphenicol and tetracyclines. Sulphonamides- mechanism and action of sulpha drugs, preparation and uses of sulphadiazine, sulphapyridine, sulphathiazole and sulphafurazole; Vitamins-classification as water soluble and liquid soluble vitamins, sources, deficiencies and assay of vitamins A,B_1, B_2 and C

UNIT III Analgesics and Antiseptics

Narcotic analgesics-isolation, pharmacological action and uses of morphine, heroin and codeine; Synthetic analgesics-pethidine and methodone; Antipyretic analgesics-synthesis and structure and action of methyl salicylate, aspirin, paracetamol and phenacetin; Antiseptics and disinfectants-phenol as disinfectant and phenol coefficient; dyes and organo mercurials and cationic surfactants

UNIT IV Anaesthetics, Tranquilisers and Antineoplastics

Anaesthetics - classification as general, local and intravenous anaesthetics, chemistry of anaesthetic ether, nitrous oxide, halothane, chloroform, thiopental sodium methohexitone, cocaine and benzocaine; Alkaloids - detection of alkaloids, colour reagents; Isolation, colour reaction and SAR of quinine; Tranquilisers, hypnotics and sedatives; Antineoplastic and hypoglycemic agents - detection sugar and serum in urine; cause and control of diabetes; Oral hypoglycemic agents; causes and control of cancer; Praparation and uses of thiotepa and cyclophosphoramide.

UNIT V Organic pharmaceutical aids

Preservatives and antioxidants, colouring, flavouring and sweetening agents and ointment bases; Blood-blood groups, Rh factor, blood pressure normal, high and low; control of pressure; Causes and control of anaemia-antianaemic drugs, coagulants and anticoagulants; causes and control of AIDS.

Text Books

1. T.C. Daniels and E.C. Jorgensen, **Text book of organic medicinal and pharmaceutical chemistry**, J. B. Lippincott, Philadelphia, 1977.
2. Ashutosh Kar, **Medicinal Chemistry**, New Age International, 1996.

Reference Books

1. M. Gordon, **Psychopharmacological agents**, Academic press, New York, 1965.
2. J.M. Ritchie and P.J. Cohen, **The pharmacological basis of therapautics**, 5th Edn., Macmillan, New York, 1975.
3. D.Lednicer and L.A. Mitscher, **Organic Chemistry of drug synthesis**, John Wiley &Sons, New York, 1959.
4. J.E. Hoover, **Remington's Pharmaceutical sciences**, 15th Edn. Mack Publ.Company, Easton, 1975.

15CYS08 APPLIED CATALYSIS

Hours	L	T	P	C
72	4	0	0	4

UNIT I Reaction Rates

Activation energy concepts - arrhenius theory, collision theory – biomolecular and unimolecular reactions, ARR theory, influence of □S, □H and □G on reaction rates with and without catalyst.

UNIT II Homogeneous Catalysis

Concepts of acidity – Bronsted – Lewis acids. Concept of base – Brosted – Lewis bases. Acid base strength. Application of acid – base catalysis – alkylation, oxidation and reduction of organic molecules. Advantage and disadvantage of homogeneous catalysts.

UNIT-III Heterogeneous Catalysis

Metal and metal oxide catalyst - Metal oxide supported catalyst, polymer supported catalyst. Solid acid and base catalyst – molecular sieves – neutral catalyst – alumino phosphate molecular sieves. Isomorphous substitution. High temperature reactions. Product selectivity concept – pore size, reactant ratio, time on stream, coke deposition and conversion.

UNIT IV Photocatalysts

Light absorption, laws of photochemistry, quantum yield, semiconductor concept, photo chemical application of dye degradation, molecular sieves based photo chemical applications.

UNIT V Enzyme Catalysts

Reaction specificity, enzyme catalysis mechanism – induced fit, lock and key. Coenzyme – mechanism. Factors influencing enzyme action – temperature, pH, enzyme concentration and substrate concentration. Michaelis – Menton theory and Lineweaver – Burk plot.

Text Books

1. K.J. Laidler, **Chemical Kinetics,** IIIrd Edn., Harper and Row publisher, New York, 1987.
2. B.Viswanathan, **Catalysis: Principles and applications,** Narosa Publ., New Delhi, 2004.
3. V. Ramamurthy, **Photochemistry in organized and constrained media**, VCH Edn., New York, 1991.

Reference Books

1. V. Murugesan, **Recent trends in catalysis**, Narosa publ., New Delhi, 2004.
2. K. Kalyanasundaram, **Photochemistry in microheterogenous systems**, Academic Press, New York, 1987.
3. Samuel H. Maron, **Principles of Physical Chemistry**, Mac Millan, Publisher, New York, 1972.
4. E. Conn and K.Stump, **Outlines of Biochemistry**, John Wiley and Sons, 1987.
5. Friedlich Liebau, **Structural Chemistry of Silicates,** Springer-Verlog, Berlin, 1985.

XVII Model question Papers

(For the candidates admitted from 2015 onwards)

M.Sc., DEGREE EXAMINATION

15CYC101 ORGANIC CHEMISTRY – I

Time: Three hours Maximum : 75 marks

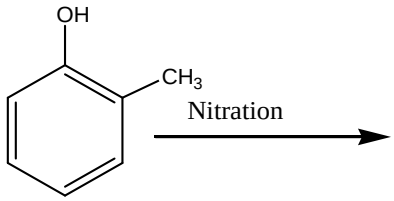
SECTION A – (5 x 2 = 10 Marks)
(Answer *all* the questions)

1. Give any two methods for the generation of nitrenes.

2. What are anti-aromatic compounds?

3. Write about the stereochemistry of S_Ni reaction.

4. What will be the product of the following reaction?



5. Write an example for enantiotopic ligands.

SECTION B – (5 x 5 = 25 Marks)
(Answer *all* the questions)

6. (a) Explain structure, generation and reactivity of carbenes.

Or

(b) Explain the kinetically and thermodynamically controlled reactions.

7. (a) Discuss the aromaticity of the azulenes.

Or

(b) Give any two methods of synthesis of imidazoles.

8. (a) Write any distinguishing features existing between S_N1 and S_N2 mechanisms.

Or

(b) Explain elaborately about the mechanism of neighbouring group participation.

9. (a) Discuss the arenium ion mechanism for the aromatic electrophilic substitution reaction and give evidences in favour of it.

Or

(b) Explain the factors that facilitate the S_E2 mechanism in the aliphatic compounds.

10. (a) Write briefly on Cram's rule.

Or

(b) Explain the optical activity of spiranes.

SECTION B – (5 x 8 = 40 Marks)

(Answer *all* the questions)

11. (a)What is an isotope effect? Discuss the use of isotope effects in the determination of reactionmechnism. (8)

Or

(b) (i) State and explain Hammond postulate. (4+4)

(ii) How stereochemical evidence helpful in determining the reaction mechanism?

12. (a) (i) Discuss about the aromaticity of annulenes. (4+4)

(ii) Explain the mechanism of substitution reaction in oxazole and thiazole.

Or

(b) (i) Explain the aromaticity of ferrocenes.

(ii) What is homoaromaticity? Explain with examples.

13. (a) Give examples of ambient nucleophiles and state what factors determine their mode of action and regioselectivity.

Or

(b) (i) Explain why the trans-2-chlorocyclohexanol gives an excellent yield of epoxy cyclohexane but the cis isomer gives none?

(ii) Bridgehead halides are slow in nucleophilic substitution reaction. Account for this. (4+4)

14. (a) (i) Compare the rates of nitration of benzene, nitrobenzene and phenol. (3+2+3)

(ii) Explain the mechanism of Riemer-Tiemann reaction.

(iii) Explain the mechanism of sulphonation of benzene.

Or

(b) Write the mechanisms of the following reactions

(i) Gatterman,

(ii) Gatterman-Koch,

(iii) Vilsmeir,

(iv) Reimer-Tiemann reaction.

15. (a) Write elaborately on asymmetric synthesis.

Or

(b) (i) Write short note on the optical activity of biphenyls.

(ii) Write short note on the chirality of transcyclooctene. (4+4)

****

(For the candidates admitted from 2015 onwards)

M.Sc., DEGREE EXAMINATION

15CYC102 INORGANIC CHEMISTRY – I

Time : Three hours Maximum : 75 marks

PART-A (Answer ALL questions) 5 x 2 = 10 marks

1. What is van der waals bonding?
2. State wade's rule?
3. What are non-stoichiometric compounds?
4. What is threshold energy?
5. What are betatron and bevatron?

PART-B (Answer ALL questions) 5 x 5 = 25 marks

6. (a) Explain HSAB concept

(Or)

(b) Explain bonding and structure of silicates

7. (a) Explain styx notation

(Or)

(b) Explain the structure of Metallo carboranes

8. (a) Explain ferrimagnetism.

(Or)

(b) Explain diffusion mechanism

9. (a) Explain of nucleus shell model

(Or)

(b) Explain spallationr

10. (a) Explain cloud chamber.

(Or)

(b) What are the uses of radioisotopes in analytical chemistry

PART-C (Answer ALL questions) 5 x 8= 40 marks

11. (a) Write notes on Molecular sieves.

(Or)

(b) Discuss various allotropes of carbon

12. (a) Discuss the chemistry of low molecularity metal clusters.

(Or)

(b) Discuss the theory of multiple metal-metal bonds

13. (a) Discuss the theory of superconductors.

(Or)

(b) write notes on inorganic phosphors

14. (a) Write the different type of nuclear reactions

(Or)

(b) Discuss the theories of fission

15. (a) Write notes on cyclotron

(Or)

(b) Discuss the applications of radioisotopes in analysis

******

(For the candidates admitted from 2015 onwards)

M.Sc., DEGREE EXAMINATION

15CYC103 PHYSICAL CHEMISTRY -I

Date: Time: 10.00 am – 01.00 Noon. (3 hours)

PART-A (Answer ALL questions) 5 x 2 = 10 marks

1. What are threshold and activation energies?
2. How will you calculate ionic strength?
3. Define Secondary salt effect.
4. What are the factors affecting catalysis?
5. What do you infer from Freundlich adsorption isotherm?

PART-B (Answer ALL questions) 5 x 5 = 25 marks

6. (i) Write notes on quantum mechanical tunneling.

(Or)

(ii) Explain ARR Theory

7. (i) Write and explain isotopic effect.

(Or)

(ii) Write note on flash photolysis.

8. (i) What is catalysis? Explain acid base catalysis.

(Or)

(ii) What are the factors affecting enzyme catalysis

9. (i) Describe unimolecular and bimolecular reactions.

(Or)

(ii) What are the factors affecting adsorptions?

10. (i) Draw the neat sketch of Jablanski diagram.

(Or)

(ii) State and explain static and dynamic quenching.

PART-C (Answer ALL questions) 5 x 8= 40 marks

11. (i) Write note on the consecutive and parallel reactions.

(Or)

(ii) (a) Describe Potential energy surface

(b) Explain Lindemann theory for unimolecular reactions.

12. (i) Deduce the Hammett and Taft equation

(Or)

(ii) Explain the Marcus theory of electron transfer reactions

13. (i) Write note on the Fronsted relations and Homogeneous and Heterogeneous catalysis.

(Or)

(ii) Explain the mechanism of Michaelis-Menton reactions

14. (i) Write note on the Temkin and BET adsorption isotherm

(Or)

(ii) Derive the Gibbs and Langmuir adsorption isotherm

15. (i) Deduce the Stern-Volmer equation

(Or)

(ii) (a) Write note on solar energy conversion and its storage.

(b) Define the following terms (a) Eximers (b) Exciplexes

****

(For the candidates admitted from 2015 onwards)

M.Sc., DEGREE EXAMINATION

15CYE01 Elective Course - ANALYTICAL CHEMISTRY

Date: Time: 10.00 am –01.00 Noon. (3 hours)

PART-A (Answer ALL questions) 5 x 2 = 10 marks

1. Define the terms mean and median with an example.
2. In the analysis of Fe (ppm), following values were obtained. 15.42, 15.56, 15.68, 15.51, 15.52, 15.52, 15.53, 15.54, 15.53, 15.56. State values are acceptable and which can be rejected?
3. How will you analyse trace elements in solutions.
4. Define (a) Chelate (b) Tetradentate chelating agent.
5. Identify the valid numeric string variables from the following list and point out the reason for the invalidity
   (a) 1Chemistry (b) $GAS (c) 8THION$ (d) COMPD1$

PART-B (Answer ALL questions) 5 x 5 = 25 marks

6. (i) Calculate the mean and the standard deviation for the following set of data were obtained from the replicate determination of the lead content of a blood sample: 0.752, 0.756, 0.752, 0.751 and 0.760 ppm Pb. (5)

   (Or)

   (ii) Give reasons for determinant errors. How can they be minimized? (5)

7. (i) Why should the sampling process is important and what are the different methods of sampling process. (5)

   (Or)

   (ii) Enumerate the methods and equipments needed for micro scale manipulation. (5)

8. (i) What are complexometric titrations? Explain with an example. Outline the advantages of complexometric titrations (5)

   (Or)

   (ii) Explain the terms ‘stepwise’ and ‘overall’ stability constants. How they are related? (5)

9. (i) Construct the titration curve of weak acid versus strong base for 100 mL of 0.01 M CH_3COOH being titrated with 0.01 M NaOH. (5)

   (Or)

   (ii) Describe the neutralization of a polyprotic acid with a strong base (5)

10. (i) Write a programme in BASIC to calculate the pH of a basic buffer. (5)

    (Or)

    (ii) Write a programme in BASIC to calculate the pH of an acidic buffer. (5)

PART-C (Answer ALL questions) 5 x 8= 40 marks

11. (i) An atomic absorption method for the determination of the amount of iron present in used jet engine oil was found, from pooling 30 triplicate analysis, to have a standard deviation s = 2.4 μg Fe/mL. If s is a good estimate of σ, calculate the 95 % confidence

interval for the result, 18.5 μg Fe/mL, if it was based on (a) single analysis, (b) the mean of two analysis (8)

(Or)

(ii) (a) Apply the Q test to the following data set to determine whether the outlying result should be retained or rejected at the 95% confidence level.
41.27, 41.61, 41.84, 41.70 Note: Q_{crit} for 4 observations at 95 % confidance = 0.829 (2)

` (b) Explain t - test, z test, and F test (6)

12. (i) What are importance of dry box /glove box in micro chemical laboratory (8)

(Or)

(ii) Enumerate the guidelines for achieving quality in trace analysis (8)

13. (i) Briefly discuss the titrations involving monodentate and multidentate ligands. (8)

(Or)

(ii) Write a note on:
(a) Masking agents (2)
(b) Demasking agents (2)
(c) Direct titrations (2)
(d) Indirect titrations (2)

14. (i) Construct a curve for the titration of 50 mL of a 0.1 M solution of HCl with a 0.1 M solution of NaOH in the following volumes. During the course of the titration calculate the pH after addition of 0.00, 25.00, 30.00, 35.00, 40.00, 45.00, 47.00, 49.00, 49.50, 49.80, 49.90, 50.00, 50.01, 50.05, 50.10, 50.20, 50.50, 60.00, 70.00, 80.00, 100.00 mL of NaOH. (8)

(Or)

(ii) (a) Write shot notes on redox titrations. Explain briefly the application of redox titrations. (4)

(b) The feasibility of redox titrations depends largely on the respective E° Ox / Red values. Explain. (4)

15. (i) Explain the BASIC constants and variables with suitable examples. (8)

(Or)

(ii) (a) Discuss briefly the Internet usages in Chemistry (4)

(b) Discuss briefly the essential requirement for the preparation of a research report (4)

****

XVIII. List of Question paper setters / Examiners

From Periyar University & Affiliated Colleges		Outside Periyar University	
S. No.	**Name and Address**	**S. No.**	**Name and Address**
1.	Dr. V. Raj Professor and Head Department of Chemistry Periyar University, Salem – 636 011	1.	Dr. N. Dharmaraj Professor, Department of Chemistry Bharathiar University Coimbatore – 641 046
2.	Dr. P. Viswanathamurthi Professor Department of Chemistry Periyar University, Salem – 636 011	2.	Dr. S. Muthusamy Professor ,Department of Chemistry Bharathidasan University, Tituchirapalli – 24
3.	Dr. D. Gopi Professor Department of Chemistry Periyar University, Salem – 636 011	3.	Dr. M.G.Sethuraman. Professor and Head Department of Chemistry Gandhigram Rural University Gandhigram - 624 302, Dindigul District
4.	Dr. A. Lalitha Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	4.	Dr. P. Manisankar Professor and Head Department of Industrial Chemistry Alagappa University, Karaikudi-630003
5.	Dr. R. Rajavel Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	5.	Dr. P. S. Mohan Professor, Department of Chemistry Bharathiyar University, Coimbatore – 641 046
6.	Dr. V. Sujatha Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	6	Dr. R. Karvembu Associate Professor Department of Chemistry National Institute of Technology Tiruchirapalli
7.	Dr. K. Shanmuga Bharathi Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	7.	Dr. T. Raju Professor Department of Analytical Chemistry University of Madras, Guindy Campus, Chennai-600 025
8.	Dr. B. Muthulakshmi Associate Professor and Head Department of Chemistry Govt. Arts College, Salem – 636 007.	8.	Dr. K. Krishnasamy Associate Professor Department of Chemistry Annamalai University, Annamalai Nagar, Chidambaram
9.	Mrs. R. Thilagam Associate professor and Head Department of Chemistry Sarada college for women Salem – 636 016	9.	Dr. S. Abraham John Assistant Professor Department of Chemistry Gandhigram Rural University Gandhigram - 624 302 ,Dindigul District