SHIVIJI UNIVERSITY, KOLHAPUR

M.Sc. Chemistry Syllabus

Revised Implemented from 2012-13

Applicable for University Departments & Affiliated Colleges Centers

A] Ordinance and Regulations:-

O. M.Sc.

1.1) Any person who has taken the degree of B.Sc. of this University or the degree of any other statutory University recognized as equivalent, be admitted to the examination for the degree of M.Sc. in Chemistry.

1.2) A student shall be held eligible for admission to the M.Sc. course provided he/she has passed the B.Sc. examination with chemistry principal subject and has passed the entrance examination conducted by the university.

1.3) The students with B.Sc. form other Universities shall be eligible if they qualify through entrance examination and they score minimum 50% marks at B.Sc. examination and on merit.

1.4) While preparing the merit list for M.Sc. admission the performance at B.Sc. part – III (Chemistry) and the performance at the entrance examination will be given equal weightage (50-50).

Regulation: R. M.Sc. 2

2.1) The M.Sc. degree will be awarded only after successful completion of written and practical university examination

R. M.Sc. 4:

1) The entire course of M.Sc. shall be of 2400 marks so that each semester shall have 600 marks i.e. 400 Theory + 200 practical. There shall be internal evaluation of 20% for theory papers.

4.2) The examination shall be split up into four semesters.

4.3) The commencement and conclusion of each semester shall be notified by the university from time to time

4.4) There shall be a university examination for theory and practicals at end of each semester. The evaluation of theory and practicals examination be done by internal and external examiners (50:50)

4.5) In each semester there shall four theory papers and two practical courses.

4.6) A student who has passed in semester examination shall not be allowed to take the examination in the same semester again.

4.7) Each theory papers in each semester as well as each practical course shall be treated as separate head of passing.

4.8) The student is allowed to keep term in the III semester even if he/she has failed in three papers

4.9) The result shall be declared at the end of each semester examination as per University rule

B] Shivaji University, Kolhapur.

Revised Syllabus for Master of Science

1. **TITLE: Subject:- Chemistry (Inorganic , Organic, Physical and Analytical)**

   Compulsory under the faculty of Science

2. **YEAR OF IMPLIMENTATION :**

   New Syllabus will be implemented from June 2012 on wards.

3. **PREAMBLE : (Applicable to University Department and University affiliated colleges centers)**

   Total No. of Semester – 4

(Two semesters per year)

Total No. of Papers – 16

Total No. of Practical course – 08

No. of papers (theory) per semester – 04

No. of practicals course per semester – 2

Maximum marks per paper (practical) 100

Distribution of Marks – Internal evaluation	20
External evaluation (Semester exam.)	80
Total Marks for M.Sc. Degree	
Theory Papers	1600
Practical course	800
	2400

4. GENERAL OBJECTIVES OF THE COURSE:

Chemistry is a pervasive subject. All the branches of science need chemistry. It is an experimental science and students need to train in practicals to get expertise in doing fine experiments and handle sophisticated instruments. Along with the data obtained its statistical analysis is also required to establish authenticity in the fields like environmental science, space chemistry and biotechnology. There are immense potentialities for chemistry post graduates to undertake advanced research or in Industries as skilled chemists.

5. Duration:

- The Course shall be a full time course
- The duration of course shall be two years consist of four semesters

FEE STRUCTURE:

Entrance Examination Fees	**:**	As prescribed by Shivaji University, Kolhapur
Course Fee	**:**	As prescribed by Shivaji University, Kolhapur.

6. IMPLEMENTATION OF FEE STRUCTURE: --

7. ELGIBILITY FOE ADMISSION:

As per O.M.Sc. 1.2 for graduates of this university and O.M.Sc. 1.3 from other Universities and the merit list.

8. MEDIUM OF INSTRUCTION : English.

9. STRUCTURE OF COURSE:

SEMESISTER

Semester - I

Theory courses:	Paper No.		Title
	G-11101	CH- I :	Inorganic Chemistry.-I
	G-11201	CH-II :	Organic Chemistry.-I
	G-11301	CH-III :	Physical Chemistry-I.
	G-11401	CH-IV :	Analytical Chemistry-I.
Practical courses :			
	G-11601	CH-111- I	Relevant practicals.
	G-11701	CH-112-II	

Semester -II

Theory courses	Paper No.	Title of paper.
G-21101	CH-V	Inorganic Chemistry - II.
G-21201	CH-VI	Organic Chemistry - II.
G-21301	CH-VII	Physical Chemistry - II.
G-21401	CH-VIII	Analytical Chemistry -II.

Practicals courses

G-21601	CH-211-III
G-21701	CH-212-IV

M.Sc.-II (General outline for each Branch).

Following codes will be used for papers of Part-II.

ICH : Inorganic chemistry
OCH : Organic chemistry
PCH : Physical chemistry.
ACH : Analytical chemistry.

Semester – III.

The students shall opt. three papers and one elective in each specialization.

Theory courses:

Inorganic chemistry : Core papers : ICH-IX, ICH-X, ICH-XI
Elective : ICH- XII (A to C)
Organic chemistry : Core papers : OCH-IX, OCH-X, OCH-XI,
Elective : OCH- XII (A to C).
Physical chemistry : Core papers : PCH-IX, PCH-X, PCH-XI,
Elective : PCH-XII (A to C).
Analytical chemistry : Core papers : ACH-IX, ACH-X, ACH-XI,
Elective : ACH-XII (A to C).

Practical courses :

Semester – III

Two practical courses relevant to each Specilization :			**Practicals**
Inorganic Chemistry	: ICH- 311 and	ICH- 312,	V&VI
Orgnanic Chemistry	: OCH-311 and	OCH-312,	V&VI
Physical Chemistry	: PCH-311 and	PCH-312.	V&VI
Analytical Chemistry	: ACH-311 and	ACH-312.	V&VI

Semester– IV

The students shall opt. three papers and one elective in each specialization.

Theory courses :

Inorganic chemistry	:	Core papers	: ICH-XIII, ICH-XIV, ICH-XV
		Elective	: ICH- XVI (A to C)
Organic chemistry	:	Core papers	: OCH-XIII, OCH-XIV, OCH-XV,
		Elective	: OCH- XVI (A to C).
Physical chemistry	:	Core papers	: PCH-XIII, PCH-XIV, PCH-XV,
		Elective	: PCH-XVI (A to C)
Analytical chemistry	:	Core papers	: ACH-XIII, ACH-XIV, ACH-XV,
		Elective	: ACH-XVI (A to C).

Practicals

Two practical courses relevant to each Specialization :		**Practicals**
Inorganic Chemistry :	ICH- 411 and ICH- 412,	VII&VIII
Orgnanic Chemistry :	CH-411 and OCH-412,	VII&VIII
Physical Chemistry :	PCH-411 and PCH-412.	VII&VIII
Analytical Chemistry :	ACH-411 and ACH-412.	VII&VIII

10. 1.3 Scheme of examination : **(Applicable to University Department and University affiliated colleges centers)**

- The semester examination will be conducted at the end of each term (both theory and practical examination)
- Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term. Two practicals will be of 100 marks each.
- Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

1.4 Standard of Passing

As per rules and regulation of M.Sc. course.

1.5 Nature of question paper and scheme of marking

Theory question paper: Maximum marks -80

Total No. of question – 7

All questions are of equal marks. Out of these seven questions five questions are to be attempted.

Question No.1 is compulsory and objective

Total no. of bits – 16, Total marks – 16 (which cover multiple choices, fill in the blanks, definition, true or false). These questions will be answered along with other questions in the same answer book.

.Remaining 6 question are divided into two sections, namely section-I and section – II. Four questions are to be attempted from these two section such that not more than two questions from any of the section. Both sections are to be written in the same answer book.

1.4 Standard of Passing

As per rules and regulation of M.Sc. course.

C] OTHER FEATURES : University Department

INTAKE CAPACITY	:	96 Students	Organic: 30 Inorganic: 30 Physical: 20 Analytical:16
		University affiliated College Centers :Self Supporting courses	
INTAKE CAPACITY	:	20 students for each center.	

D) Laboratory Safety Equipments:

Part: I Personal Precautions:

1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.

4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part: II: Use of Safety and Emergency Equipments:

1. First aid Kits
2. Sand bucket
3. Fire exextinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Date sheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments.

Credit system (Applicable to University department)

Credits can be defined is the workload of a student in

1. Lectures
2. Practicals
3. Seminars
4. Private work in the Library/home
5. Examination
6. Other assessment activities

How much time a student gives for the examination per semester?

1) **4** Theory papers per semester each of the three hour duration. Time required is **12** hours
2) **2** Practicals per paper with **2** experiments per practical. Total 4 practical each of **3** hour duration. Time required is **12** hour.

Total time for a semester examination is **12 + 12 = 24** hrs

Time required for the other activities.

Seminars-as per the requirement of the course (minimum 2, One for each semester)

Library-book issue, Journal reference, reviews writing of research papers, internet access. Reading magazines and relevant information

Private work – project material, Industrial training, book purchase, Xerox, availing outside facilities etc

Home- Study, notes preparations, computations etc

Types of Credits

1) Credits by examination- test(theory and practical)

2) Credits by non examination- Proficiency in the state , national and international sports achievements, project, Industrial training , participation in workshop, conference, symposia etc

Social service (NSS) Military service (NCC) Colloquium & debate, Cultural programs etc

Credits by lectures and Practicals

- Total instructional days as per the UGC norms are **180**.
- 1 credit is equivalent to **15** contact hours
- For the M Sc course there are **4** theory papers with **4** hours teaching per week

Therefore the instructional days for the theory papers in semester are **4** x **15**(weeks) = 6**0**

- There are **4** practicals (with 1 project) each of **6** hour duration for the **2** practical courses.
  Total practical workload is **12** hours per week. Thus instructional days for the practical course of **4** practicals are **2** (practical papers) x **15 = 30**

The time for each student is busy in a semester is **90** days (Theory) + 6**0** days (Practical) = 15**0** days

- With **4** credits per theory paper will be **4 x 4=16** credits and 4 credits per practical will be **4 x 2= 08** credits

Credits for the practicals

Every practical (project) of **50** marks carries **2** credits.
Number of credits for M Sc course per semester will be **16 + 8 = 24**. Total no credits for entire M Sc course will be **4 x 24 = 96**.
There will be 4 credits for other assessment activities-
Total credits for entire M Sc course will be
Theory course, **4** credits x **16 = 64**
Practical course, **4** credits x **8 = 32**
Other activities **4** credits = **04**
Total = **100** credits

How to restructure the M. Sc course implementation of the credit system?

There will not be a major change in the restructured course. However some minor modification can be made in the syllabus wherever necessary.
In order to implement the credit system effectively it is necessary to make every semester duration of at least **12** weeks.
The examination must be scheduled in one month's time
The students must get at least 3 weeks time for the examinations preparations.
Every theory papers syllabus should consists of 4 units (sub units allowed) each carrying 1 credit.

In order to have uniformity in the credit transfer it is necessary to have internal examination in all the P.G. departments of equal weightage. **80** external + **20** internal appears to be ideal to begin with.

Theory paper	contact hours	credits
Unit-1 (sub units if any)	15	1
Unit-2(sub units if any)	15	1
Unit-3 (sub units if any)	15	1
Unit-4(sub units if any)	15	1

The practical course credit distribution

Practical paper	Practical	Contact hours	Credits	no of practicals
I (Unit-1)	1	6	2	12
I (Unit-1)	2	6	2	12
II (Unit-1)	3	6	2	12
II (Unit-1)	4	6	2	12

A project of **50** marks will be carrying **2** credits. Where a project of **50** marks is offered to the student, the student will have to perform 1 project, 1 practical paper (2 practical) for that semester. Time for the explanation for the practical course (contact ours) will be 1 week (12 hours)

This makes the practical workload of the student equal to **60** days in a semester.

Grades, grade point and average grade point's calculations

Table showing the grades, grade points and marks scored by a student

Grades	**Grade points**	**marks out of 100**
A^+	9	91 to 100
A	8	81 to 90
A^-	7	71 to 80
B^+	6	61 to 70
B	5	51 to 60
B^-	4	41 to 50
C+	3	31 to 40
C	2	21 to 30
C-	1	11 to 20
F	0	0 to 10

Sum grade point average SGPA) :- It is a semester index grade of a student

1. SGPA = $(g_1xc_1) + (g_2xc_2) +$ -------- $+ (g_6xc_6)$/ Total credits offered by a student in a semester.
2. Cumulative grade point average (CGPA):- It is cumulative index grade point average of student

CGPA = $(g_1xc_1) + (g_2xc_2) +$ -------- $+ (g_6xc_6)$/Total no of credits offered by students up to and including semester for which the cumulative average is required.

3. Final grade point average (FGPA): - It is a final index of student in the course FGPA=$(n/\sum c_i \times g_i) /(n/ cl)$

Where c_1- credit of the course (paper) (4)

g_{i-} grade point secured (see the table for conversion)

n- No of courses (no of paper offered)

cl- Total no credits for the entire M Sc course (100)

Illustration with an hypothetical case

For M Sc I (or II/III/IV)

1 papers	I	II	III	IV	Practicals	I	II	III	IV
2 credits	4	4	4	4		2	2	2	2 = 24
3 grade point Obtained	7	6	8	6		7		7	= 41
4 $\sum c_i \times gi$	28	24	32	32		28		28	= 164

5 $\sum c_i \times gi/cl$ =164/24 = 6.83

6 Overall grade = 6.83

The cumulative grade point average is the sum of SGPA of student of every semester.

Suppose it is 164(6.83) for semester- I, 170(7.08) for semester -II, 168 (7.0) for semester III and 176 (7.33) for semester IV.

The cumulative average for semester I and II will be = 334/48 = 6.958 = 6.96

Final grade point average for all semesters = 678/96 = 7.0265 = 7.03

Rules for opting the credits

1. A student from same department only will be eligible for opting the specialization of the choice.
2. It will be mandatory for a student admitted for a specialization to opt for the papers related to that specialization Other papers can not be offered as credits in lieu of these papers
3. Admission to the students from the other specialization for the credits will be restricted to 5 core papers only. A student from other department will be offered credits of his choice in multiples of 4. A theory paper can be offered as the credit. However number of such admissions will depends upon the seats available class room seating capacity.
4. Any student can have credits from the management course. In order to increase the employability of the students it is necessary that add on course in management be offered by the department of management. Separate fees can be charged from the students for taking this course. Such course can be arranged during the vacation.

M. Sc. Part – I (Semester – I)

Paper CH – I: Inorganic Chemistry – I

UNIT-I
Wave mechanics [15]

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, the wave equation, the theory of hydrogen atom, particle in one dimensional box, transformation of coordinates, Separation of variables and their significance.

UNIT-II
Stereochemistry and Bonding in main group compounds [15]
VSEPR theory &drawbacks, Pπ– Pπ, Pπ–dπ and dπ– dπ bonds, Bent rule, Hybridization involving f-orbital energies of hybridization, some simple reactions of covalently bonded molecules.

Unit-III [15]
a) Chemistry of transition elements (10)

General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, stereochemistry of coordination compounds, ligand field theory, splitting of d orbitals in low symmetry environments, Jahn- Teller effect, Interpretation of electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic series, metal clusters, sandwich compounds, metal carbonyls

b) Bioinorganic Chemistry (05)

Role of metal ions in biological processes, structure and properties of metalloproteins in electron transport processes, cytochromes, ferrodoxins and iorn sulphur proteins, ion transport across membranes, Biological nitrogen fixation, PS-I, PS – II, Oxygen uptake proteins.

UNIT-IV
Electronic, Electric and Optical behaviour of Inorganic materials [15]

Metals, Insulators and Semiconductors, Electronic structure of solid, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap, temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single

crystal growth, zone refining, fractional crystallization, semiconductor devices, rectifier transistors, optical devices, photoconductors, photovoltaic cells, solar batteries.

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
3) J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
4) A. R. West, Plenum, Solid State Chemistry and its applications
5) N. B. Hanney, Solid State Physics
6) H. V. Keer, Principles of Solid State
7) S. O. Pillai, Solid State Physics
8) W. D. Callister, Wiley, Material Science and Engineering: An Introduction
9) R. Raghwan, First Course in Material Science
10) R. W. Cahan, The coming of Material Science
11) A. R. West, Basic Solid State Chemistry, 2nd edition
12) U. Schubest and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
13) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
14) A. H. Hanney, Solid State Chemistry, A. H. Publications
15) O. A. Phiops, Metals and Metabolism
16) Cullen Dolphin and James, Biological aspects of Inorganic Chemistry
17) Williams, An Introduction to Bioinorganic Chemistry
18) M. N. Hughes, Inorganic Chemistry of Biological Processes
19) Ochi, Bioinorganic Chemistry
20) John Wulff, The structure an properties of materials
21) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
22) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
23) Willam L. Jooly, Modern Inorganic Chemistry
24) Manas Chanda, Atomic Structure and Chemical bonding
25) N. N. Greenwood and A. Earnshaw, Chemistry of elements,. Pergamon
26) Chakraburty, Soild State Chemistry, New Age International
27) S. J. Lippard, J.M . Berg, Principles of bioinorganic Chemistry, University Scienc e Books
28) G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier
29) Progress Inorganic chemistry , Vol 18 and 38, J. J. Loppard, Wiley

Paper –CH-102: Organic Chemistry-I
UNIT-I
a) Reaction Mechanism: Structure and Reactivity (8)

Types of reactions, strength of acids and bases. Generation, structure, stability and reactivity of carbocations and carbanions, free radicals, carbenes, arynes, nitrenes and ylids. Efect of structure on reactivity, resonance and field , steric effects.

b) Aliphatic Nucleophilic substitutions: (7)

The SN^2, SN^1 and SN^i reactions with respects to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridge head carbon, competition between SN^1 and SN^2,Ambident nucleophiles, Neighbouring Group Participation.

UNIT-II

a) Aromatic Electrophilic Substitutions:- (8)

Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems, energy profile diagrams. The ortho/para ratio, ipso attack, concept of aromaticity, orientation in their ring systems. Diazo-coupling, Vilsmeie reaction, Von Richter rearrangement . Nucleophilic aromatic substitution reactions SN^1, SN^2.

b)Addition to Carbon–Carbon Multiple Bonds: (7)

Mechanism and stereochemical aspects of the addition reactions involving electrophiles and free radicals, region- and chemo-selectivity, orientation and reactivity. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Michael addition reaction.

UNIT-III

a) Elimination Reactions: (8)

The E1, E2 and E1cB mechanisms. Orientation in Elimination reactions. Hofman versus Saytzeff elimination, Pyrolytic syn-elimination, competition between substitution and elimination reactions, Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions. Pyrolytic elimination reactions.

b) Study of following reactions: (7)

Beckman, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen, Witting, Neberland Prins, Ortaon, Hofmann-Martius and Demjanov reaction..

UNIT-IV (15)

Stereochemistry: Concept of chirality and molecular dissymmetry, Recognition of symmetry elements and chiral centers, Prochiral relationship, homotopic, enantiotopic and disteriotopic groups and faces. Recemic modifications and their

resolution, R and S nomenclature. Geometrical isomerism E and Z. nomenclature. Conformational analysis : Cyclohexane derivatives, stability and reactivity, Conformational analysis of disubstituted cyclohexanes.

RECOMMENDED BOOKS

1. A guide book to mechanism in Organic chemistry (Orient-Longmens)- Peter Sykes
2. Organic Reaction Mechanism (Benjamin) R. Breslow
3. Mechanism and Structure in Organic chemistry (Holt Reinh.)B. S. Gould.
4. Organic Chemistry(McGraw-Hill)Hendrikson, Cram and Hammond.
5. Basic principles of Organic Chemistry (Benjamin) J. D.Roberts and M. C. Caserio.
6. Reactive Intermediates in Organic Chemistry (John Wiley)N. S. Issacs.
7. Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel
8. Organic Stereochemistry (McGraw-Hill) by Hallas.
9. Organic Reaction Mechanism (McGraw-Hill) R. K. Bansal.
10. Organic Chemistry- R. T. Morrison and R. N. Boyd,(Prentice Hall.)
11. Modern Organic Reactions(Benjumin) H. O. House.
12. Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13. Reaction Mechanism in Organic Chemistry- S. M. Mukharji and S. P. Singh.
14. Stereochemistry of Organic compoundsc) D. Nasipuri.
15. Advanced Organic Chemistry (McGraw-Hill) J. March.
16. Introduction to stereochemistry(Benjumin) K. Mislow.
17. Stereochemistry by P. S. Kalsi (New Age International)

Paper –CH-103: PHYSICAL CHEMISTRY – I

UNIT-I: THERMODYNAMICS

[15]

Introduction, revision of basic concepts: Ideal and non-ideal solutions, Rault's law. Duhem-Margules equation and its applications to vapor pressure curves (Binary liquid mixture). Extensive and intensive properties. Gibbs-Duhem equation and its applications to study of partial molar quantities. Henry's law. Thermodynamics of nonelectrolyte solutions. Excess and mixing thermodynamic properties. Entropy and third law of thermodynamics. Methods of determining the practical absolute entropies. Entropies of phase transition.

Maxwell relations, thermodynamic equation of state, chemical potential, variation of chemical potential with temperature & pressure. Equilibrium constants and general conditions of equilibrium in terms of thermodynamic potentials.

UNIT-II: STATISTICAL THERMODYNAMICS

[15]

Weights and configurations, the most probable configuration, thermodynamic probability and entropy: Boltzmann – Planck equation. Ensembles, ensemble average and time average of property. Maxwell-Boltzmann (MB) distribution law and its application to viscosity and diffusion of gases. Partition function and its significance. Rotational, translational, vibrational and electronic partition functions. Use of spectroscopic data for evaluation of various partition functions. Relationship between partition function and thermodynamic properties. Sackur tetrode equation. Calculation of equilibrium constant using Partition function.

UNIT-III: SURFACE PHENOMENA

[15]

Adsorption, adsorption isotherms, surface area determination, Gibbs adsorption equation and its verification, Surface tension, electrical phenomena at interfaces including electrokinetic effects, micelles, reverse micelles, solubilization. Thermodynamics of micellisation, factors affecting critical micelle concentration (cmc), experimental methods of cmc determination. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces. Significance of surface phenomena in advanced technologies like nanotechnology, drug formulation etc.

UNIT-IV: BIOPHYSICAL CHEMISTRY

[15]

Introduction to biophysical chemistry: Amino acids, peptide, proteins, enzymes, nucleic acids: Introduction to primary, secondary, tertiary and quaternary structures, acid base properties. Intermolecular forces: H- bonding, Van der Waals forces, Lenard-Jones potential, columbic interactions, 1-4 interactions, hydrophobic hydration and interaction.

Protein folding/defolding phenomena, use of spectroscopic and thermodynamic tools for protein-ligand binding equilibrium study, hydrodynamic and equilibrium thermodynamic methods for determination of molar mass of biological macromolecules.

Reference books

1. Physical Chemistry – P. W. Atkins, Oxford University press, 8th edition, 2006.
2. Text book of Physical Chemistry – S. Glasstone.
3. Principles of Physical Chemistry – Marron and Pruton.
4. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
5. Thermodynamics for Chemists – S. Glasstone, D. Van Nostrand , 1965.
6. Thermodynamics: A Core Course- R. C. Srivastava, S. K. Saha and A. K. Jain, Prentice-Hall of India, IInd edition, 2004.
7. Elements of statistical thermodynamics - L. K. Nash, 2nd Ed. Addison Wesley 1974.
8. Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists - S. Glasstone, D. Van Nostrand Company, Inc., 1944.
9. An Introduction to Statistical Thermodynamics – T.L. Hill, Addison-Wesley. 1960.
10. Statistical Mechanics – Donald A. McQuarrie, 2000.
11. Physical chemistry of surfaces – A. W. Adamson, 4th Ed. John Wiley, 1982.
12. Introduction to Colloid and Surface Chemistry – D. Shaw, Butterworth Heinemann, 1992.
13. Surface Activity: Principles, Phenomena and Applications (Polymers, Interfaces and Biomaterials) – K. Tsujii, 1st Ed. Academic Press, 1998.
14. Biophysical Chemistry – J.P. Allen, Wiley-Blackwell, 2008.
15. Biophysical Chemistry – A. Cooper, RSC, 2004.
16. Thermodynamics of Biochemical Reactions – R.A. Alberty, Wiley-Interscience, 2003.
17. Textbook of Biophysical Chemistry – U.N. Dash, McMillan India, 2006.

Paper CH-IV Analytical Chemistry –I

UNIT-I

a)Errors and treatment of Analytical Chemistry [7]

Errors, Determinant, constant and indeterminate. Accuracy and precision Distribution of random errors. Average derivation and standard derivation, variance and confidence limit. Significance figures and computation rules. Least square method. Methods of sampling: samples size. Techniques of sampling of gases, fluid, solids, and particulates.

b) Nano materials: [8]

1. Possible hazards and health effects of nanomaterials
2. What is nanotechnology?
3. Nanoscale building blocks and its applications
   Zero dimensional nano materials
   One dimensional nano materials
   Two dimensional nano materials

UNIT-II

Chromatographic methods: [15]

General principle, classification of chromatographic methods. Nature of partition forces. Chromatographic behavior of solutes. Column efficiency and resolution.

Gas Chromatography: detector, optimization of experimental conditions. Ion exchanges chromatography. Thin layer chromatography: coating of materials, prepative TLC. Solvents used and methods of detection Column chromatography: Adsorption and partition methods. Nature of column materials.

Preparation of the column. Solvent systems and detection methods.

UNIT-III

Electroanalytical Techniques: [15]

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principles, instrumentation, nature of titration curves, and analytical applications.

UNIT-IV [15]

Computational Chemistry:

Computers in chemistry: Hardware and software's: data representations, flow chart and writing simple programs in FORTRAN and c-languages e.g. solving quadratic equation, least square fitting, and titration curves etc. Use of excel for data fitting and calculations.

Introduction to computational tools such as molecular mechanics, molecular dynamics, visualation of chemical models and related softwares.

RECOMMENDED BOOKS

1. Analytical Chemistry: (J.W) G. D. Christain
2. Introduction to chromatography : Bobbit
3. Instrumental Methods of analysis (CBS)- H.H . Willard, L.L. Mirrit, J.A. Dean
4. Instrumental Methods of Analysis : Chatwal and Anand
5. Instrumental Methods of Inorganic Analysis(ELBS) : A.I. Vogel
6. Chemical Instrumentation: A Systematic approch- H.A. Strobel
7. The principals of ion-selective electrodes and membrane transport: W.E.Morf
8. Physical Chemistry – P.W.Atkins
9. Principal of Instrumental Analysis- D. Skoog and D.West
10. Treatise on Analytical Chemistry: Vol Ito VII – I.M. Kolthoff
11. Computer, Fundamentals-P.K.Sinha
12. Programming in BASIC : E. Balaguruswamy
13. Computer programming made simples : J.Maynard.

M. Sc. Part I Inorganic Chemistry Practical Course
(Practical no. 111 and 112)

1. Ore analysis – '2' ores
2. Alloy analysis – '2' (Two and three components)
3. Inorganic Preparations and purity – '4'

References:

1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
2) Experimental Inorganic Chemistry - W. G. Palmer
3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A.R. Powell, Charles, Griffin and Company Limited

SEMISTER-I

ORAGNIC CHEMISTY PRACTICALS

A) Preparations

(One stage preparations involving various types of reactions)

1.Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2.Aldol condensation: Dibenzal acetone from Benzaldehyde.
3.Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.
4.Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5.Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and p-Bromoaniline.
6.Preparation of Cinnamic acid by Perkin's reaction.
7.Knoevenagel condensation reaction

8.Coumarin Synthesis
9.Synthesis of Heterocyclic compounds.
10. Synthesis of Dyes
B)Estimations:
1.Estimation of unsaturation.
2.Estimation of formalin.
3.Colorimetric Estimation of Dyes
4.Estimation of Amino acids
(Any suitable Expt. may be added.)
REFERENCE BOOKS
1.A text book of practical organic chemistry- A. I. Vogel.
2.Practical organic chemistry- Mann and Saunders.
3.A handbook of quantitative and qualitative analysis- H. T. Clarke.
4.Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester I
Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half hours duration.
Experiments are to be set up in the following techniques.
1. Potentiometry:
Determination of solubility and solubility product of silver halides, determination of binary mixture of weak and strong acid etc.
2. Conductometry :
Determination of mixture of acids and relative strength of weak acids.
3 Refractometry :
Determination of molecular radius of molecule of organic compound.
4 Polarimetry :
Kinetics of inversion of cane sugar in presence of strong acid.
5 Chemical Kinetics :
Kinetics of reaction between bromate and iodide.
6 Partial Molar Volume :
Determination of PMV by intercept method, density measurements etc.
(New experiments may also be added)

Books recommended for Practicals :
1 Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
2 Text Book of Quantitative inorganic analysis : A.I. Vogel.

3 Experimental Physical Chemistry : R.C.Das and B. Behera
4 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan
5 Experimental Physical Chemistry :V.D. Athawale and Parul Mathur.
6 Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K. Chondhekar

M. Sc. Part-I Semester-I
Practicals in Analytical Chemistry.

Physical Chemistry Section
1) To verify Beer-Lambert's Law for potassium permanganate solution and hence to
determine the molar extinction coefficient and unknown concentration of given sample colorimetrically
2) To determine the solubility of calcium oxalate in presence of KCl (Ionic Strength
Effect)
3) To determine the solubility of calciuum oxalate in presence of HCl (H+ ion Effect)
(Any other experiments may be added)
Organic Chemistry Section
1 Analysis of Pharmaceutical tablets.
2 To verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.
3 To estimate the amount of D-glucose in given solution colorimetrically.
4 To determine the acid value of given oil
(Any other experiments may be added)
Inorganic Chemistry Section
1 Determination of sodium from the fertilizer sample using cation exchange chromatographically.
10
2 Determination of calcium from given drug sample.
3 Determination of hardness, alkalinity and salinity of water sample
4 Separation and estimation of chloride and bromide on anion exchanger.
(Any other experiments may be added)

M. Sc. Part – I (Semester – II)

CH 201: Inorganic Chemistry – II

UNIT-I [15]
Chemistry of non – Transition elements

General discussion on the properties of the non – transition elements, special features of individual elements, synthesis, properties and structure of halides and oxides of the non – transition elements, Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur – nitrogen compounds, peroxo compounds of boron, carbon,sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

UNIT-II

a) Organometallic Chemistry of transition elements [08]

Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation), pi metal complexes, activation of small molecules by coordination

b) Metal – ligand equilibria in solution [07]

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of formation constants by pH – metry, spectrophotometry methods.

UNIT-III

Studies and applications of Lanthanides and Actinides [15]

Spectral and magnetic properties, use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides, Organometallic chemistry applications of lanthanide and actinide compounds in Industries.

UNIT-IV [07]

a) Chemistry in Non- aqueous solvents, Classification of solvents, properties, leveling effect, type reactions in solvents, chemistry of liquid ammonia, liquid dinitrogen tetraoxide and anhydrous sulphuric acid with respect to properties, solubilities and reactions.

b) Nuclear and radiochemistry [08]

Radioactive decay and equilibrium, nuclear reactions, Q value, cross-sections, types of reactions, chemical effects of nuclear transformation, fission and fusion, fission products and fission yield

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
3) J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
4) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
5) Jones , Elementary coordination Chemistry
6) Martell, Coordination Chemistry
7) T. S. Swain and D. S. T. Black, organometallic Chemistry
8) John Wulff, structure and properties of materials, vol – 4, electronic properties, Wiley Eastern
9) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
10) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
11) Willam L. Jooly, Modern Inorganic Chemistry
12) Manas Chanda, Atomic Structure and Chemical bonding
13) P. L. Pauson, Organometallic Chemistry
14) H. S. Sisler, Chemistry in non – aqueous solvents, Reinhold Publishing Corporation, USA, 4th edition (1965)
15) H. J. Arnikar, Essentials of Nclear Chemistry
16) Friedlander, Kennedy and Miller, Nuclear and Radiochemistry

Paper-CH-202: Organic Chemistry-II

UNIT-I

a) Study of following reactions: [10]

Mechanism of condensation reaction involving enolates Mannich, Benzoin, Stobbe, Dieckmann, Diels-Alder, Robinson annulation, Reimer-Tieman, Chichibabin, Baeyer-Villiger oxidation, Simon-Smith, Vlhmann, Mc-Murry, Dakin

[05]

b) Alkylation and Acylation

Introduction, Types of alkylation and alkylating agents: C-Alkylation and Acylation of active methylene compounds and their applications.

UNIT-II

a) Hydroboration : [05]

Mechanism and Synthetic Applications

b) Enamins : Formation and reactivity of enamines [05]

c) Oxidation:Applications of oxidizing agents like $KMnO_4$, chromium trioxide, manganese dioxide, Osmium tetraoxide, Woodward-Prevost hydroxylation, DDQ, Chloranil, hydrogen peroxide [05]

UNIT-III

a) Reductions: [08]
Study of following reductions- Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol, Fe in HCl.
b) Protection of functional group: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [07]

UNIT-IV
a) Study of Organometallic compounds: [08]
Organo-lithium, organo cobalt, Fe, Ce, Ti, Cd. Use of lithium dialkyl cuprate, their addition to carbonyl and unsaturated carbonyl compounds.
b) Methodologies in organic synthesis : [07]
Ideas of synthones and retrones, Functional group transformations and inter conversions of simple functionalities.

RECOMMONDED BOOKS
1.Modern synthetic reactions-(Benjamin) H. O. House.
2.Reagents in organic synthesis-(John Wiley) Fieser and Fieser
3.Principles of organic synthesis-(Methuen) R. O. C. Norman
4.Hydroboration- S. C. Brown.
5.Advances in Organometallic Chemistry- (A.P.)F. C. A. Stone and R. West.
6.Organic Chemistry (Longman)Vol. I & Vol. II- Finar
7.Oxidation by-(Marcel Dekker) Augustin
8.Advanced Organic chemistry 2nd Ed. R R. Carey and R. J. Sundburg.
9.Tetrahydron reports in organic chemistry- Vol.1, No. 8.
10.Organic Synthesis-(Prentice Hall)R. E. Ireland.
11.Homogeneous Hydrogenation-(J. K.) B. R. James.
12.Comprehensive Organic Chemistry- (Pargamon) Barton and Ollis.
13.Organic reactions- various volumes- R. Adams.
14.Some modern methods of Organic synthesis-(Cambridge) W. Carruthares.

Paper-CH-203: PHYSICAL CHEMISTRY – II

UNIT-I: QUANTUM CHEMISTRY

[15]

Introduction: Operators and related theorems, algebra of operators, commutator, linear operators, uncertainty principle, postulate of quantum mechanics, properties of wave functions, Schrodinger equation, wave function and its interpretation.

Normalization and orthogonality, Eigen functions and Eigen values. Solutions of wave equation for a free particle and particle in a box problem. Transition dipole moment integral and selection rules. Application to electronic spectra of conjugated linear organic molecules. Linear and angular momentum, eigen function and eigen values of angular momentum operator, Ladder operator, addition of angular momenta. Spin angular momenta, symmetric and antisymmetric wavefunctions, Pauli Exclusion Principle, spectroscopic term symbols

UNIT-II: PHOTOCHEMISTRY

[15]

Absorption of light and nature of electronic spectra, electronic transition, Frank-Condon principle, selection rules, photo-dissociation, pre-dissociation, Photo physical phenomena: Electronic structure of molecules, molecular orbital, electronically excited singlet states, designation based on multiplicity rule, life time of electronically excited state, construction of Jablonski diagram, electronic transitions and intensity of absorption bands, photo-physical pathways of excited molecular system (radiative and non-radiative), prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photo-excited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisional V quenching and Stern-Volmer equation. Photochemistry of environment: Greenhouse effect

UNIT-III: ELECTROCHEMISTRY

[15]

Debye - Huckel theory of inter-ionic attraction, ionic atmosphere, time of relaxation, relaxation and electro-phoretic effects, Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions. Abnormal ionic conductance of hydroxyl and hydrogen ions. Activity coefficients: forms of activity coefficients and their interrelationship. Debye-Huckel limiting law for osmotic and activity coefficients of dilute electrolytic solutions and its applications to concentrated solutions. Debye-Huckel-Bronsted equations. Quantitative and qualitative verification of

Debye-Huckel limiting law, Bjerrum theory of ion-ion association. Types of electrode, Determination of activity coefficients of an electrolyte using concentration cells, degree of dissociation of monobasic weak acid (approximate and accurate), instability constant of silver ammonia complex. Acid and alkaline storage batteries.

UNIT-IV: CHEMICAL KINETICS

[15]

Experimental methods of following kinetics of a reaction, chemical and physical (measurement of pressure, volume, EMF, conductance, diffusion current and absorbance) methods and examples. Steady state approximation and study of reaction between NO_2 and F_2, decomposition of ozone, and nitrogen pentoxide. Ionic reaction: Primary and secondary salt effect, Homogeneous catalysis: acid and base catalyzed reactions, Michaelis–Menten enzyme catalysis. Heterogeneous catalysis: Adsorption of gas on a surface and its kinetics, Catalyzed hydrogen-deuterium exchange reaction.

Reference books

1. Introductory Quantum Chemistry - A. K. Chandra. Tata McGraw-Hill. 1988.
2. Physical Chemistry: A molecular Approach – Donald A. McQuarrie and John D. Simon, Viva Books, New Delhi, 1998.
3. Quantum Chemistry – Donald A. McQuarrie, Viva Books, New Delhi, 2003.
4. Physical Chemistry – P. W. Atkins, Oxford University press, VIth edition, 1998.
5. Quantum Chemistry - W. Kauzmann, Academic press.
6. Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists - S. Glasstone, D. Van Nostrand Company, Inc., 1944.
7. Quantum Chemistry - R.K. Prasad, New Age International, New Delhi.
8. Physical Chemistry – R.S. Berry, S.A. Rice, J. Ross, 2nd Ed., Oxford University Press, New York, 2000.
9. Photochemistry – J. G. Calverts and J. N. Pitts, John-Wiley & Sons
10. Fundamentals of Photochemistry- K. K. Rohatgi-Mukharjii, Wiley Eastern
11. Introduction to Photochemistry-Wells

12. Photochemistry of solutions-C. A. Parker, Elsevier
13. An Introduction to Electrochemistry by S. Glasstone
14. Modern Electrochemistry Vol. I & II by J. O. M. Bockris and A.K.N. Reddy.
15. Electrolytic Solutions by R. A. Robinson and R. H. Strokes, 1959
16. Chemical Kinetics-K. J. Laidler, Pearson Education,2004
17. Kinetics and Mechanism - A. A. Frost and R. G. Pearson.
18. Electrochemistry- S. Glasstone, D. Van Nostrand , 1965
19. Advanced Physical Chemistry- Gurdeep Raj, Goel Publishing House
20. Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill
21. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.

Paper CH-VIII Analytical Chemistry- II

UNIT-I

a) Introduction to Spectroscopy: (03)

Introduction, region of electromagnetic radiations, definitions and units of wavelength, frequency, energy, amplitude, wave number and their relations, Interactions of radiation with matter, rotational, vibrational, electronic energy levels, types of spectroscopy methods.

b) Ultraviolet and visible spectrophotometry (UV-VIS) : (05)

Introduction, Beer-Lambert's law, instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, applications.

b) Infrared Spectroscopy (IR) : (07)

Introduction, principle of IR spectroscopy, instrumentation, fundamental modes of vibrations, types of vibrations, condition for IR absorption, IR regions, sampling technique, selection rules, characteristic of IR absorption of common functional groups and applications.

UNIT-II

a) Nuclear Magnetic Resonance (NMR): (08)

Introduction, principles, Magnetic and non magnetic nuclei, precessional motion, Larmor frequency, absorption of radio frequency. Instrumentation (FT-NMR). Sample preparation, shielding and deshielding effects, chemical shift, internal standards, factors influencing chemical shift, solvents used, peak area and proton

ratio, anisotropic effect, spin-spin coupling, coupling constant, applications to simple structural problems

b) Mass spectroscopy (MS) : (07)
Introduction, Principle, Instrumentation, working of mass spectrometer (double beam). Determination of molecular formula, Formation of different types of ions, Mclafferty rearrangements, metastable ions or peaks, The nitrogen rule, Mass spectrum of alkanes, alkenes, alkynes, cycloalkanes, cycloalkenes, cycloalkynes, and applications.

UNIT-III

a) Nephelometry and Turbidometry : (05)
Introduction, Theory, Instruments, working and Applications

b) Radiochemical Analysis: (05)
Neutron Activation Analysis(NAA), Scintillation counter and G.M. Counter

c) Mossbauer Spectroscopy: (05)
Basic principles, spectral parameters and spectral display, application of studies of bonding structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin and Sn^{+2} and Sn^{+4} compounds.

UNIT-IV

a) Atomic Absorption Spectroscopy : (10)
Introduction, Principle, difference between AAS and FES, Advantages of AAS over FES, advantages and disadvantages of AAS. Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences and applications.

b) Inductively coupled Plasma Spectroscopy: (05)
Introduction, Nebulisation Torch, Plasmas, Instrumentation, Interferences and Applications

REFERENCE BOOKS

1. Instrumental Methods of analysis- Willard, Merrit, Dean and Settle.
2. Spectroscopic identification of organic compounds- R.M. Silverstein and G.C. Bassler
3. Spectroscopic methods in organic chemistry- D.H. Williams and I. Fleming
4. Absorption spectroscopy of organic molecules- V.M. Parikh
5. Applications of spectroscopic techniques in Organic chemistry- P.S. Kalsi
6. A Text book of Qualitative Inorganic Analysis- A. I. Vogel
7. Physical Methods in Inorganic Chemistry (DWAP)- R. Drago
8. Fundamentals of Analytical Chemistry – D.A. Skoog and D.M. West (Holt

Rinehart and Winston Inc)

M. Sc. Part – I (Semester - II)
CH – 201: Inorganic Chemistry Practical Course
(Practical no. 211 and 212)

1. Ore analysis – '2' ores
2. Alloy analysis – '2' (Two and three components)
3. Inorganic Preparations and purity – '4'

References:

1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
2) Experimental Inorganic Chemistry - W. G. Palmer
3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A. R. Powell, Charles, Griffin and Company Limited

SEM-II

ORGANIC CHEMISTRY PRACTICLES

1.Qualitative analysis:
Separation and identification of the two component mixtures using Chemical and physical methods.
2.Thin layer chromatography (TLC).
3.Column chromatography and steam distillation techniques.
4.Determination of percentage of Keto-enol form.
5.Estimation of pesticides
(Any other suitable experiments may be added).

REFERENCE BOOKS

1.A text book of practical organic chemistry- A. I. Vogel.
2.Practical organic chemistry- Mann and Saunders.
3.A handbook of quantitative and qualitative analysis- H. T. Clarke.
4.Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester II

Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half-hours duration.

Experiments are to be set up in the following techniques.

1 Potentiometery:
Determination formal redox potential of system, determination of binary mixture of halides.

2. Conductometry :
Titration of ternary acid mixture of acids, Verification of Onsagar Equation for 1:1 type strong electrolyte.

3 Refractometry :
Determination of atomic refractions of H, C and Cl atoms.

4 Cryoscopy:

Determination of apparent weight and degree of dissociation a strong electrolyte equilibrium methods.
5 Chemical kinetics:
Kinetics of iodination of acetone in presence of strong acid etc.
6 Phase Equilibrium:
Three component system etc.
(New experiments may be also be added)
Books recommended for Practicals :
1. Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
2. Text Book of Quantitative inorganic analysis : A.I. Vogel.
3. Experimental Physical Chemistry : By F. Daniels and J. Williams
4. Experimental Physical Chemistry : R.C Das and B.Behera
5 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan

M. Sc. Part-I Semester-II
Practicals in Analytical Chemistry.

Physical Chemistry Section
1 To estimate the amount of NH4Cl colorimetrically using Nesseler's Reagent.
2 Determine the solubility of lead iodide in presence of varying concentration of salt
KCl.
3 Determine the solubility of lead iodide in presence of varying concentration of salt
KNO3
(Any other experiments may be added)

Organic Chemistry Section
1 Analysis of pharmaceutical tablets: Ibrufen / INAH
2 Colorimetric estimation of drugs.
3 Preparation of pesticides.
4 Column and thin layer chromatography
(Any other experiments may be added)
Inorganic Chemistry Section
1 To determine the amount of copper in brass metal alloy colorimetrically.
2 Separation and estimation of Copper and Cobalt on cellulose Column.
4 Separation and estimation of Nickel and Cobalt on a anion exchanger.
5 Separation and estimation of Iron and aluminium on a cation exchanger.
(Any other experiments may be added)
Recommended books
1 A Text book of quantitative Inorganic Analysis – A.I.Vogel
2 Standards methods of Chemical Analysis-F.J. Welcher.
3 Experimental Inorganic Chemistry – W.G.Palmer.
4 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and

C.A.Moghe
5 Inorganic synthesis- King.
6 Synthetic Inorganic Chemistry-W.L.Jolly
7 EDTA Titrations –F.Laschka

M. Sc. Part-I Semester-II
Practicals in Analytical Chemistry.
Physical Chemistry Section

1 To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
2 Determine the solubility of lead iodide in presence of varying concentration of salt KCl.
3 Determine the solubility of lead iodide in presence of varying concentration of salt KNO_3 (Any other experiments may be added)

Organic Chemistry Section

1Analysis of pharmaceutical tablets: Ibrufen / INAH
2 Colorimetric estimation of drugs.
3 Preparation of pesticides.
4 Column and thin layer chromatography
(Any other experiments may be added)

Inorganic Chemistry Section

1 To determine the amount of copper in brass metal alloy colorimetrically.
2 Separation and estimation of Copper and Cobalt on cellulose Column.
3 Separation and estimation of Nickel and Cobalt on a anion exchanger.
4 Separation and estimation of Iron and aluminium on a cation exchanger.
(Any other experiments may be added)

Recommended books

1 A Text book of quantitative Inorganic Analysis – A.I.Vogel
2 Standards methods of Chemical Analysis-F.J. Welcher.
3 Experimental Inorganic Chemistry – W.G.Palmer.
4 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe
5 Inorganic synthesis- King.
6 Synthetic Inorganic Chemistry-W.L.Jolly
7 EDTA Titrations –F.Laschka

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