Shivaji University, Kolhapur
'Department of Applied Chemistry'

M. Sc. Part-I

Semester I & II

M. Sc. Part-II

Semester III & IV

Revised Syllabus

[Revised Syllabus under Academic Flexibility Credit System & CBCS Pattern]

(To Be Implemented from June- 2013)

(Subject to the modifications to be made from time to time)

Overview and Revised syllabus for the M. Sc course in Applied Chemistry

Co-ordinator….

SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF APPLIED CHEMISTRY

Aim and Objective of M. Sc. Course in "Applied Chemistry"

M.Sc. Course in Applied Chemistry is a potential base provided by the Shivaji University, Kolhapur on University campus to educate and prepare post graduate students from rural and urban area who will get employment on large scale in academic institutes, R & D and Quality control laboratories of Indian chemical/pharmaceutical industries as well as multinational and forensic Laboratories.

The M.Sc. course in Applied Chemistry aims to provide students with broad theoretical and applied background in all specialization of Chemistry with emphasis on analytical techniques. Particular attention is given to industrial applications of applied & advanced knowledge of Chemistry so that students are completely equipped to move into careers in academic, research, industrial and commercial organizations. The M. Sc. course in Applied Chemistry is providing broad common frame work of syllabus to expose our young graduates to the recent and applied knowledge of interdisciplinary branches of chemistry involving applied organic, inorganic, physical, analytical, industrial, pharmaceutical, polymer, nanoscience & technology. The laboratory course particularly emphasis on green chemistry approach elaborating the need for waste minimization, substitution of non toxic chemicals and increasing the use of microscope and computational techniques, The laboratory courses are designed to provide an exhaustive and hands on working with various modern instruments. Final Semester is dedicated to project work giving students experience in solving real life problem under the supervision of faculty members involved in percuing research and development projects usually related to industrial problem.

Employment potential of the course:

To provide properly qualified manpower for academic institutions R & D and QC laboratories of Indian chemical/pharmaceutical industries research organizations and forensic laboratories. M.Sc. course in Applied Chemistry can be helpful to the students to be self employed as it not only allows for an in-depth subject specific knowledge and opportunities to specializing in number of areas at the leading edge of the subject but also encourage students to develop problem solving and reflective working practices.

Title of the Course: M. Sc. Applied Chemistry.
Year of Establishment of Course: June 2007
Duration of the Course: '2' Year (4 Semester)
Intake to the course: 60 + 10% [45% Open + 45% Reserve + 10% Other University]

Eligibility of Course: Admission to the M. Sc. Applied Chemistry course will be open to candidates passing B. Sc degree in Chemistry of Shivaji University or any other statutory university, Institution in India or abroad with minimum 55% marks the candidate should have Chemistry as a principal subject of study at B.Sc. Course.

Selection Procedure: Selection for the M. Sc. course in Applied Chemistry will be based on common all India entrance test of Department of Chemistry and personal interviews passing standard for open category minimum 50% marks for reserve

category minimum 40% marks will be called for personal interview. The merit list of eligible candidates will be displayed on Shivaji University web site. www.unishivaji.ac.in

Teaching faculties:

1. Professor & Co-ordinator, - **Prof. P. N. Bhosale**
2. Three- Assistant Professors
3. Contributory Intra and Inter Departmental faculty - 10 Professors, 10 Associate Professors and 5 Assistant Professors
4. Experts from National institutes, universities and Industries

The structure of M. Sc. Applied Chemistry Course:-

1) Theory course
2) Practical course
3) Seminars/ Tutorials
4) Industrial training/ Project work

Each semester will have theory examination of four papers of 100 marks each (Internal assessment caring a weighatage of 20 % will be conducted after the coverage of 50% syllabus and semester examination will carry a weightage of 80% conducted at the end of completion of semester duration)

Practical Course:

Each Semester will have two practical courses of 100 marks each will be given to end examination of Semester.

Semester-IV will have two practical courses out of which one practical course will have 50 marks project work/ Industrial training completed in the industries/Laboratory.

Project Work/ Industrial Training/Review Articles: The evaluation of project work /Industrial Training/ Review Articles will be based on the work carried out in industry/ laboratory/ library and viva-voce/oral examination will be conducted jointly by internal & external examiner at the end of examination of semester IV.

In case of industrial training the candidate shall be required to submit a certificate from the industry that he/she has undergone training and also one typed copy of the project report submitted to university duly certified by Head of the Department. The project report will be evaluated by the two examiners. The candidate concern will have to give power point presentation of his/her project in a viva voce examination.

Discipline:

Every student is require to observe discipline and good behavior both inside and outside the institution/ Department and not to indulge in any activity which will tend to bring down the prestige of University/ Department

Evaluation and Credit System:

SEMESTER-I

Course No	Title	Hours per week		Examination/Evaluation of marks				
				Theory		Practical		Total
		L	P	Internal	Final	Internal	Final	
APC-101/I	Inorganic Chemistry-I	4		20	80	--	--	100
APC-102/II	Organic Chemistry-I	4		20	80	--	--	100
APC-103/III	Physical Chemistry-I	4		20	80	--	--	100
APC-104/IV	Analytical Chemistry-I	4		20	80	--	--	100
APC-P 111/I	Inorganic Practical-I	--	3	---	--	--	50	50
	Organic Practical -I	--	3	---	--	--	50	50
APC-P 112/II	Physical Practical -I	--	3	---	--	--	50	50
	Analytical Chemistry -I	--	3	---	--	--	50	50

Total Marks for Semester-I 600

*Distribution of teaching hours/week: - Theory – 16 hours, Practical – 12 hours

Total hours – 28 hr

SEMESTER II

Course No	Title	Hours per week		Examination/Evaluation of marks				
				Theory		Practical		Total
		L	P	Internal	Final	Internal	Final	
APC-201/V	Inorganic Chemistry-II	4	---	20	80	---	---	100
APC-202/VI	Organic Chemistry-II	4	---	20	80	---	---	100
APC-203/VII	Physical Chemistry-II	4	---	20	80	---	---	100
APC-204/VIII	Analytical Chemistry-II	4	---	20	80	---	---	100
APC-P 211/III	Inorganic Chemistry-II	---	3	---	---	---	50	50
	Organic Chemistry –II	---	3	---	---	---	50	50
APC-P 212/IV	Physical Chemistry –II	---	3	---	---	---	50	50
	Analytical Chemistry -II	---	3	---	---	---	50	50

Total Marks for Semester-II 600

*Distribution of teaching hours/week: - Theory – 16 hours, Practical – 12 hours

Total hours – 28 hr

M.Sc. Part II, Applied Chemistry

SEMESTER III

Course No	Title	Hours per week		Examination/Evaluation of marks				
				Theory		Practical		Total
		L	P	Internal	Final	Internal	Final	
APC-C 301/IX	Applied Inorganic Chemistry-I	4	---	20	80	---	---	100
APC-C 302/X	Applied Organic Chemistry-I	4	---	20	80	---	---	100
APC-C 303/XI	Applied Physical Chemistry-I	4	---	20	80	---	---	100
APC-E 304/XII [A]	Advance Organic Chemistry-I	4	---	20	80	---	---	100
APC-E 304/XII [B]	Applied Analytical Chemistry-I	4	---	20	80	---	---	100
APC-E 304/XII [C]	Bioorganic Chemistry	4	---	20	80	---	---	100
APC-P 311/V	Applied Inorganic Chemistry	---	6	--- ---	--- ---	---	50	100
	Applied Physical Chemistry	---				---	50	
APC-P 312/VI	Applied Organic Practical –III	---	6	--- ---	--- ---	---	50	100
	Applied Physical Chemistry	---				---	50	

Total Marks for Semester-III 600

*Distribution of teaching hours/week: - Theory – 16 hours, Practical – 12 hours

Total hours – 28 hr

SEMESTER IV

Course No	Title	Hours per week		Examination/Evaluation of marks				
				Theory		Practical		Total
		L	P	Internal	Final	Internal	Final	
APC-C 401/XIII	Applied Inorganic Chemistry-II	4	---	20	80	---	---	100
APC-C 402/XIV	Applied Organic Chemistry-II	4	---	20	80	---	---	100
APC-C 403/XV	Advanced Organic Chemistry-II	4	---	20	80	---	---	100
*APC-E 404/XVI [A]	Inorganic Chemical Industries	4	---	20	80	---	---	100
APC-E 404/XVI [B]	Pollution Monitoring and Control	4	---	20	80	---	---	100
APC-E 404/XVI [C]	Applied Analytical Chemistry-II	4	---	20	80	---	---	100
APC-P 411/VII	Applied Inorganic Practical-II	---	4	---	---	---	100	100
APC-P 412/VIII	Applied Organic Practical –II	---	8	---	---	---	100	100

Total Marks for Semester-IV 600

*Distribution of teaching hours/week: - Theory – 16 hours, Practical – 12 hours

Total hours – 28 hr

* This paper is common with M. Sc. Part- II, Semester- IV Industrial Chemistry

SEMESTER WISE THEORY AND PRACTICAL COURSE OF M. Sc. APPLIED CHEMISTRY (CBCS)

M.Sc. Part – I Applied Chemistry,

Semester – I

Paper No. APC I: Inorganic Chemistry – I	4 credits
Paper No. APC II: Organic Chemistry – I	4 credits
Paper No. APC III: Physical Chemistry – I	4 credits
Paper No. APC IV: Analytical Chemistry – I	4 credits
Practical:	
1 Practical – APC-P I	4 credits
2 Practical – APC-PII	4 credits

Semester – II

Paper No. APC V: Inorganic Chemistry – II	4 credits
Paper No. APC VI: Organic Chemistry – II	4 credits
Paper No. APC VII: Physical Chemistry – II	4 credits
Paper No. APC VIII: Analytical Chemistry – II	4 credits
Practical:	
1 Practical – APC-P III	4 credits
2 Practical – APC-P IV	4 credits

Theory Syllabus and Practical Syllabus for M. Sc. Part I / Semester I & II is common with General Chemistry.

M. Sc. Part – II Applied Chemistry,

Semester – III

Core Papers

Paper No. APC-C IX: Applied Inorganic Chemistry – I	4 credits
Paper No. APC-C X: Applied Organic Chemistry – I	4 credits
Paper No. APC-C XI: Applied Physical Chemistry – I	4 credits

Elective Papers

Paper No. APC-E XII [A]: Advanced Organic Chemistry – I	4 credits
Paper No. APC-E XII [B]: Applied Analytical Chemistry– I	4 credits *Paper
No. APC-E XII [C]: Bioorganic Chemistry	CBCS Pattern

Practical:

1 Practical – APC-P V (Inorganic & Analytical)	4 credits
2 Practical – APC-P VI (Organic & Physical)	4 credits

Semester – IV

Core Papers

Paper No. APC-C XIII: Applied Inorganic Chemistry – II	4 credits
Paper No. APC-C XIV: Applied Organic Chemistry – II	4 credits
Paper No. APC-C XV: Advance Organic Chemistry – II	4 credits

Elective Papers

*Paper No. APC-E XVI [A]: Inorganic Chemical Industries	4 credits
Paper No. APC-E XVI [B]: Pollution Monitoring and Control	4 credits
Paper No. APC-E XVI [C]: Applied Analytical Chemistry – II	4 credits

Practical:

1	Practical – APC-P VII (Inorganic & Analytical)	4 credits
2	Practical – APC-P VIII (Organic & Analytical)	4 credits

Out of 3 elective papers students have to choose one paper for Sem – III & Sem – IV and/or select one paper of Choice Based Credit System (CBCS).

16 Papers x 4 Credits = 64 Credits
8 Practical x 4 Credits = 32 Credits
96 Credits (Credits by examination)
+ 04 Credits (Credits by non examination)
100 Credits

* This paper is common with M. Sc. Part- II, Semester- IV Industrial Chemistry

SHIVAJI UNIVERSITY KOLHAPUR

DEPARTMENT OF APPLIED CHEMISTRY

Implementation of the Credit system choice based credit system (CBCS) with effect from June 2013

Credits as defined is the workload of a student in

1. Lectures
2. Practicals
3. Seminars
4. Examination
5. 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 Practical papers with 2 experiments per paper. Total 4 practical each of 3 hour duration. Time is 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

Library- book issue, Journal reference, internet access. Reading magazines and relevant information

Private work – project material, book purchase, Xerox, availing outside facilities etc
Home- Study, notes preparations, computations etc

Types of Credits

1) Credits by examination- test(theory and practical) Seminars **96 Credits**
2) Credits by non examination- Proficiency in the state , national and international sports achievements, Social service (NSS) Military service (NCC) Colloquium & debate, Cultural programs, creative writing etc **04 Credits**
Total Credits of the course = 100 Credits

Credits by lectures and practicals

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

Therefore the instructional days for the theory papers in a semester are 4 x 15(weeks) = 60

- There are 4 practicals (with 1 project) each of 3 hour duration for the 2 practical papers
  Total practical workload is 12 hours. Thus instructional days for the practical course of 4 practicals are 4 (practical papers) x 15 = 60

The time for each student is busy in a semester is 60(Theory) + 60 (Practical) = 120 days

- With 4 credits per subject there will be 4x4=16 credits for the theory papers and 4 x 2=8
  Credits for 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 in Applied Chemistry will be 4 x 24 = 96 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 15 weeks.
The examination must be scheduled in one months 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	3	2	6
I (Unit-1)	2	3	2	6
II (Unit-1)	3	3	2	6
II (Unit-1)	4	3	2	6

A project of 50 marks will be carrying 2 credits. Where a project of 50 marks is offered to he student, the student will have to perform 1 project, 1 practical paper (3 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

Grade	Marks	Grade Points
O	70 and above	7
A	60 to 69.99	6
B	55 to 59.99	5
C	50 to 54.99	4
D	45 to 49.99	3
E	40 to 44.99	2
F (Fail/ Unsatisfactory)	39.99 and below	0

Semester 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 grae 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=$(n/\sum c_i x g_i)/(n/cl)$

Where c1- 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 (96)

Illustration with a hypothetical case

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

1 papers	I	II	III	IV	Practical's	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 $\sum c_i x g_i$	28	24	32	32		28		28	= 164
5 $\sum c_i x g_i/sl$	=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) fro 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 cannot 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.

Department of Applied Chemistry
M. Sc. course in Applied Chemistry

[Under the Semester System, Academic flexibility & Credit scheme with effect from June: 2013, admission]

SYLLABUS AND SCHEME OF EXAMINATION

SEMESTER I

M. Sc. Part I- APPLIED CHEMISTRY

APC – I: INORGANIC CHEMISTRY – I 60 h

Unit-I Wave mechanics 15 h

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 h

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 a) Chemistry of Transition Elements 10h

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 05h

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 Behavior of Inorganic Materials 15 h

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.

Text Book/Reference:

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, John Wiley & Sons, 2008.
4) A. R. West, Solid State Chemistry and its applications, John Wiley & Sons, 2003.
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 and 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 Science Books,
28) G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier,
29) Progress in Inorganic chemistry, Vol 18 and 38, J. J. Loppard, Wiley,

APC-II: ORGANIC CHEMISTRY-I 60 h

Unit-I a) Reaction Mechanism: Structure and Reactivity 08h

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

b) Aliphatic Nucleophilic Substitutions: 07h

The SN2, SN1 and SNi 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 SN1 and SN2, Ambident nucleophiles, Neighbouring Group Participation.

Unit-II a) Aromatic Electrophilic Substitutions: 08h

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, Vilsmeir reaction, von Richter rearrangement . Nucleophilic aromatic substitution reactions SN1, SN2.

b) Addition to Carbon–Carbon Multiple Bonds 07h

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

Unit-III a) Elimination Reactions: 08h

The E1, E2 and E1cB mechanisms. Orientation in Elimination reactions. Hoffman 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: 07h

Beckman, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen, Wittig, Nederland prins, Ortaon, Hoffman-Martius and Demjanov reaction.

Unit-IV Stereochemistry: 15 h

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.

Text Book/Reference:

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

16. K. Mislow, Introduction to stereochemistry, Benjumin.
17. P. S. Kalsi, Stereochemistry, New Age International.

APC-III: PHYSICAL CHEMISTRY – I 60 h

Unit-I Thermodynamics 15 h

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 h

Weights and configurations, the mostprobable 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 h

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 h

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.

Text Book/Reference:

1. P. W. Atkins, Physical Chemistry, Oxford University press, VIIth edition, 2002.
2. S. Glasstone, Text book of Physical Chemistry,
3. Principles of Physical Chemistry – Marron and Pruton
4. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
5. Physical chemistry- G. K. Vemulapalli, Prentice-Hall of India, 1997.
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, 2ndEd. 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, 4thEd. 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.

APC-IV ANALYTICAL CHEMISTRY –I 60 h

Unit-I Errors and treatment of Analytical Chemistry: 07h

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.

Nano materials: 08h

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: 15h

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 methodsof 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 h**

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 Computer Science: **15 h**

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 suchas molecular mechanics, molecular dynamics, visualation of chemicalmodels and related softwares.

Text Book/Reference:

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 Semester-I
Inorganic Chemistry Practical Course
Practical No. APC-111 and APC-112

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

Text Book/Reference:

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

M. Sc. I – Semester I
Organic Chemistry 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.)

Text Book/Reference:
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. Part 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 Analytical 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 Analytical 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 Analytical Chemistry Section
1 Determination of sodium from the fertilizer sample using cation exchange chromatographically.
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)

SEMESTER II
M. Sc. Part I- APPLIED CHEMISTRY

APC-V: INORGANIC CHEMISTRY – II 60 h

Unit-I Chemistry of Non–Transition Elements 15 h

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 h

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 h

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 h

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 a) Chemistry in Non-Aqueous Solvents 07 h

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 h

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

Text Book/Reference:

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

APC-VI: ORGANIC CHEMISTRY-II 60 h

Unit-I a) Study of Following Reactions: **10h**

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

b) Alkylation and Acylation **05h**

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

Unit-II a) Hydroboration : Mechanism and Synthetic Applications **05h**

b) Enamines: Formation and reactivity of enamines **05h**

c) Oxidation: Applications of oxidizing agents like KMnO4, chromium trioxide, manganese dioxide, Osmium tetraoxide, Woodward-Prevost hydroxylation, DDQ, Chloranil, hydrogen peroxide **05h**

Unit-III a) Reductions: **08h**

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. **07h**

Unit-IV a) Study of Organometallic compounds: **08h**

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 : **07h**

Ideas of synthones and retrones, Functional group transformations and inter conversions of simple functionalities.

Text Book/Reference:

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.

APC-VII: PHYSICAL CHEMISTRY – II 60 h

Unit-I Quantum Chemistry 15 h

Introduction: Operators and related theorems, algebra of operators, commutator, linear operators, uncertainty principle, postulate of quantummechanics, 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 angularmomenta. Spin angular momenta, symmetric and antisymmetric wavefunctions, Pauli Exclusion Principle, spectroscopic term symbols

Unit-II Photochemistry 15 h

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 Jablonskidiagram, 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 h**

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 ofion-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 h**

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.

Text Book/Reference:

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.

APC-VIII ANALYTICAL CHEMISTRY- II 60 h

Unit-I Introduction to Spectroscopy: 03h

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.

a) Ultraviolet and visible spectrophotometry (UV-VIS) : 05h

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

b) Infrared Spectroscopy (IR) : 07h

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): 08h

Introduction, principles, Magnetic and nonmagnetic 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) : 07h

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

Unit-III a) Nephelometry and Turbidometry : 05h

Introduction, Theory, Instruments, working and Applications

b) Radiochemical Analysis: 05h

Neutron Activation Analysis(NAA), Scintillation counter and G.M. Counter

c) Mossbauer Spectroscopy: 05h

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 : 10h

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, Interferencesand applications.

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

Text Book/Reference:

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
Practical No. APC- 211 and APC-212

Inorganic Chemistry Practical Course

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

Text Book/Reference:

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

M. Sc. Part – I Semester - 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).

Text Book/Reference:

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 Part-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 Analytical 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 KNO_3
(Any other experiments may be added)

Organic Analytical 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 Analytical 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

SEMESTER III

M. Sc. Part II- APPLIED CHEMISTRY

APC-C IX APPLIED INORGANIC CHEMISTRY-I 60 h

UNIT-I Electronic Structure of Transition Metal Complexes 15h

Electronic absorption spectra of octahedral and tetrahedral complexes, Orgel diagrams, Tanabe-Sugano diagrams, calculation of Dq, B and ß values, selection rules, band intensities and band widths, spectra of high-spin octahedral and tetrahedral complexes of d1to d9 systems, Spectrochemical series; Adjusted crystal field theory, Nephelauxetic series, molecular orbital theory of complexes (qualitative principles involved in complexes with and without π-bonding), MO diagrams for octahedral and tetrahedral complexes and charge-transfer spectra, optical properties of Lanthanides and Actinides.

UNIT-II Magnetic Properties & Electronic Structure of Transition Metal Complexes 15h

Brief review of different types of magnetic behaviour, spin-orbit coupling, quenching of orbital angular momenta, temperature-independent paramagnetism, measurement of magnetic susceptibility using Gouy and Faraday methods, Term symbols for metal ions; Crystal field theory and its application to explain magneticproperties of coordination compounds, spin crossover; Structural effects: ionic radii and Jahn-Teller effect; octahedral vs. tetrahedral coordination, magnetic properties of Lanthanides and Actinides and splitting of f-orbitals in octahedral field.

UNIT-III Nanomaterials 15h

General introduction to nanomaterials and emergence of nanotechnology; Moore's law; synthesis of nanoparticles of gold, rhodium, palladium, platinum,

and silver; Synthesis of nanoparticle semiconductors, nanowires and nanorods; Techniques of synthesis: electroplating and electro-phoretic deposition, conversion through chemicalreactions and lithography; Thin films: Chemical vapor deposition and Atomic layer deposition techniques; Carbon fullerenes and nanotubes. Applicationsof nanoparticles.

UNIT-IV Nanoscience and Nanomaterials 15h

Introduction to nanoscience and nanotechnology, nano and Nature, Applications of nanotechnology & Nanomaterials: Nanobiotechnology, nanosensors, nanomedicines, nanophotonics, etc., Implications of nanotechnology, Futurefantasy and nanotechnology.

Classification of nanomaterials; 1D, 2D, 3D with their examples, Experimental methods for preparation of nanomaterials: Chemical and Physical, Characterization techniques for nanomaterials, Size dependent properties of nanoparticles: optical properties, M.P., surface to volume ratio.

Text Book/Reference:

1. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
2. A. W. Adamson & P. D. Fleischauer. Concepts of Inorganic Photochemistry, John Wiley & Sons (1975).
3. M. Ratner & D. Ratner. Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson Education (2003).
4. J. Schulte, Nanotechnology: Global Strategies, Industry Trends and Applications.
5. G. Schmid, Nanotechnology, Volume 1: Principles and Fundamentals.
6. L. E. Smart, E. A. Moore, Solid State Chemistry: An Introduction.
7. C. Kittel, Introduction to solid state Physics.
8. T. Pradeep, Nano The Essentials: Understanding Nanoscience and Nanotechnology.

APC-C X APPLIED ORGANIC CHEMISTRY- I 60 h

Unit I Molecular Orbital Theory 15 h

Aromaticity in benzenoids, alternant and non alternant hydrocarbon, Huckel's rule, energy level of pi molecular orbital and the concept of aromaticity, calculation of energies of orbitals in cyclic and acyclic systems and the stabilities of different systems. Calculation of charge densities, 'PMO' theory and reactivity index.

Unit II Study of the following compounds and their reactivity 15 h

(a) Aromaticity of annulenes, mesoionic compounds (sydnones), ferrocene and azulene.

(b) Study of the following; Fullerenes, Crown ethers, Cyclodextins, Cryptands, Catenanes and Rotananes.

(c) Study of the following; Benzo-fused aromatic compounds: Indoles, Quinolines and Isoquinolines, Coumarins heterocycles.

(d) Hammett equation, its applications.

Unit III Organic Photochemistry **15 h**

Photochemical processes. Energy transfer, sensitization and quenching. Singlet and triplet states and their reactivity. Photoreactions of carbonyl compounds, enes, dienes, and arenes. Norrish reactions of acyclic ketones. Patterno-Buchi, Barton, photo-Fries and Di-π methane rearrangement reactions. Photoreactions of Vitamin-D. Photochemistry of vision and photosynthesis. Singlet oxygen generation and reactions. Applications of photoreactions and their applications for industrial synthesis.

Unit IV Free radical reactions **15 h**

Types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Allylic hydrogenation (NBS) , oxidation of aldehydes to carboxylic acids, auto oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyers reaction. Hunsdiecker reaction.

Text Book/Reference:

1. J.March, "Advanced Organic Chemsitry", Wiley
2. R.O.C.Norman and A.Coxon, "Modern Synthetic Reactions", Chapman and Hall
3. M.B.Smith, "Organic Synthesis", McGraw-Hill
4. Organic Chemistry-Clayden, Greeves, Warren and Wothevs
5. R.K.Bansal, "Synthetic Applications in Organic Chemistry", Narosa
6. A guide book to mechanism in organic chemistry (orient- Longmans)- Peter Sykes
7. Organic Reaction Mechanism (Benjomin)- R. Breslow
8. Mechanism and structure in Organic Chemistry (Holt Reinhartwinston)- B. S. Gould
9. Organic chemistry (McGraaw Hill)- Hendrikson, cram and Hammond
10. Basic principles of organic chemistry (Benjamin)-J. D. Roberts and M. C. Caeserio.
11. Reactive intermediates in organic chemistry, (J. Wiley) N. S. Issacs.
12. Organic reaction mechanism (Mc Graw Hill) R. K. Bansal
13. Fundamentals of photochemistry K. K. Rohtagi- Mukherji Wiley- Eastern
14. J.Kagan, "Organic Photochemistry", Academic Press
15. J.M.Cozon and B.Holton, "Organic Photochemistry", Cambridge University Press
16. R.P.Wayne, "Principles and Applications of Photochemistry", Oxford University Press
17. C.H.Dupuoy, and O.L.Chapman, "Molecular Reactions and Photochemistry", Prentice Hall
18. Essentials of molecular photochemistry, A. Gilbert and J. Baggott. Blackwell Scientific Publication.
19. Molecular photochemistry, N.J. Urro, W. A. Benjamin
20. Introductory photochemistry. Cox and T. Camp Mc Graw –Hill
21. Photochemistry R.P. Kundall and A. Gilbert. Thomson Nelson.
22. Organic photochemistry J. Coxon and B. Hallon Cambridge University press.

APC-C XI APPLIED PHYSICAL CHEMISTRY-I 60 h

Unit I Catalysis –Principles and Applications 15h

Basic principles of catalysis: adsorption isotherms, surface area pore size and acid strength measurement. Enthalpy and entropy of adsorption: interpretation of chemisorptions based on the structure and the nature of the solid – solid state theories – role of defects in catalysis. Selection, preparation and evaluation of catalysts – test reaction, promoters, carriers and stabilizers. Mechanisms of selected reactions: hydrogenation and dehydrogenation reaction – dehydration of alcohols, olefin hydrogenation, decomposition of nitrous oxide, oxidation of CO- etonization of carboxylic acids, cracking of hydrocarbons.

Applications: petrochemical industry – reforming and refining – value added chemicals- environmental protection autoexhaust catalysts Novel catalytic material clusters, zeolites, mesoporous materials.

Electrocatalysis and Photo catalysis

Unit II Corrosion 15h

Defination, classification, chemical or dry corrosion, oxidation corrosion, corrosion by other gases. Liquid metal corrosion, Electrochemical corrosion, rusting of iron, factors influencing corrosion. Measure to prevent corrosion:- modification of environment, modification of composition of alloy, cathodic protection, inhibitors, use of protective coating, metal coating, inorganic and organic coating.

Unit III Electrodes and Fuel cell 15h

Electrodes: Different types of elctrodes. Electrochemical cells. Concentration cell and activity coefficient determination. Origin of electrode potential. Liquid junction potential. Evaluation of thermodynamic proeprties. The electrode double layer: Electrode-electrolyte interface. Theory of multiple layer capacity. Electrocapillary. Lippmann potential. Membrane potential. Elecrokinetic phenomena. Mechanism of charge transfer at electrode-electrolyte interface. Electrolysis. Current-potential curves. Dissolution, deposition and decomposition potentials. Energy barriers at metal-electrolyte interface. Different types of over potentials. Butter-Volmer equation. Tafel and Nernst equation. Rate determining step in electrode kinetics. The hydrogen over voltage. The oxygen over voltage. Theories of over voltage**.**

Fuel cell: Introduction, attractive characteristics of fuel cell, solid oxide fuel cells, cool fuel cells, phosphoric acid fuel cell, molten carbonate fuel cell, proton exchange membrane fuel cell, problems with fuel cells.

Unit IV Colloids and Emulsion 15h

The colloidal state: Introduction, types, preparation and stability of colloids, properties of colloids, Electrokinetic phenomena: Electrophoresis, electro-osmsis, Emulsion: Types of emultion, theories of emultion and emultion stability, identification of emulsion types, inversion emulsion, microemulsion: theory and application, micellisation, structure of micelle, reverse micelle, solubisation of water insoluble organic substances.

Text Book/Reference:

1. G.W.Castellan, "Physical Chemistry", Addision-Lesley Publishing Co.
2. E.A.Moelwyn Hughes, "Physical Chemistry, Pergamon Press.
3. L.C.Chapoy, "Recent Advances in Liquid Crystalline Polymers", Elsevier
4. Denbigh, "Chemical Equilibria", D Van Nostrand
5. F.W.Sears and Salinger, "An Introduction to Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics", Addison Wesely.
6. M.C.Gupta, "Elements of Statistical Thermodynamics", New Age International (P) Ltd.
7. L.K>Nash, "Elements of Statistical Thermodynamics", Addison Wesley Publishing Co.
8. Kesting and Dofman, "Statistical thermodynamics"
9. J.Rose, "Dynamic Physical Chemistry", Sir Issac Pitman & Sons
10. A.W.Adamson, "The Physics and Chemistry of Surfaces", Interscience
11. D.R.Crow, "The Principles of Electrochemistry", Chapman and Hall
12. J.O.M.Bokris and A.K.N.Reddy, "Modern Electrochemistry", Plenum Rosatta
13. D.A.MacInnes, "The Principles of Electrochemistry", Dover Publishers
14. D.A.Skoog, D.M.West and F.J.Holler, "Fundametals of Analytical Chemistry", Saunders College Publishing.
15. C.L.Wilson and D.W.Wilson, "Comprehensive Analytical Chemistry", Dan van Nostrand
16. J.G.Dick, "Analytical Chemistry, McGraw Hill
17. Abhijit Mulik, "Priciples of Physical Metullurgy" Viva Publication Delhi.

APC-E XII (A) ADVANCED ORGANIC CHEMISTRY-I 60 h

Unit I NMR Spectroscopy and Structure Elucidation 15h

Chemical shifts, anisotropic effects and coupling constants in organic compounds. Spin-spin interactions in typical systems. Analysis of 1st order spectra. implification methods for complex spectra: use of high field NMR, shift reagents, chemical exchange and double resonance. Introduction of FT (pulse) NMR; NOE; DEPT and 2DNMR. ^{13}C NMR and ^{13}C chemical shifts. Spectral interpretation and structure identification. Spectral interpretation using actual spectra taken from standard texts. The problems on structural elucidation based on spectral data.

Unit II IR and Mass Spectroscopy 15 h

Principle, characteristics, group frequencies in IR. Identification of functional groups and other structural features by IR. Hydogen bonding and IR bands. Sampling techniques. FTIR and its instrumentation. Organic mass spectroscopy. Ion production methods: El, Cl, FAB, Electrospray and MALDI. Magnetic, TOF, Quandrupole and Ion cyclotron mass analyzers. MS technique. Characteristic EIMS fragmentation modes and MS rearrangements

Unit III Organic Synthesis 15 h

C-C and C=C bond forming reactions – Mannich, Reimer-Tiemann, Simon-Smith, Vilsmeier-Haack, Reformatsky Ullmann, Stark enamine, Shapiro, wittig-horner, Peterson, Heck, Stille and McMurray reactions. Ring formation by Dieckmann,

Thorpe and Acyloin condensations. Robinson ring annulation. Synthesis of small rings. Simon-Smith reaction.

Reduction and oxidation in synthesis: Catalytic hydrogenation, Birch reduction, Hauang-Milon modification, Clemmenson reduction, LAH, Sodium borohydride as reductants, Oppenauer oxidation, m-ClC_6H_5COOOH and their applications.

Unit IV Reactions and Rearrangements 15 h

Reactions:Mechanism, with evidence of Ene Reaction, Barton, Hofmann-Loffler-Freytag, Shapiro, Sharpless asymmetric epoxidation, Suzuki, Heck, Sonogashira, Stille Coupling reactions.

Rearrangements: Mechanism with evidence, Nazarov, Meyer-Schuster, Wolff, Arylozo, Fischer, Bamberger, Smiles, Stevens, Sommelet-Hauser, Hydroperoxide and borane rearrangements.

Text Book/Reference:

1. D.H.Williams and I.Fleming, "Spectroscopic Methods in Organic Chemistry", Wiley.
2. W.Kemp, "Organic Spectroscopy", Longman
3. J.March, "Advanced Organic Chemsitry", Wiley
4. R.O.C.Norman and A.Coxon, "Modern Synthetic Reactions", Chapman and Hall
5. M.B.Smith, "Organic Synthesis", McGraw-Hill
6. R.K.Bansal, "Synthetic Applications in Organic Chemistry", Narosa
7. R.J.Simmonds, "Chemistry of Biomolecules", Royal Society of Chemistry I.L.Finar, "Organic Chemistry" Vol2 , Longman
8. R.J.Young, "Introduction to Polymer Science", John Wiley & Sons
9. F.W.Billmayer, Text Book of Polymer Science", John Wiley & Sons
10. G.Odian, "Principles of Polymerization", John Wiley & Sons
11. J.M.G.Cowie, "Polymers: Chemistry and Physics of Modern Materials", Blackie.
12. K.J.Sauders, "Organic Polymer Chemistry", Chapman and Hall
13. 13. J.B. Hendrickson, The molecules of nature.
14. Peter Bernfield, The biogenesis of natural products,
15. R.T. Slickenstaff A.C. Ghosh and G.C. Wole , Total synthesis of steroids.
16. The Chemistry of Natural products, vol. Nakanishi

APC-E XII (B) APPLIED ANALYTICAL CHEMISTRY-I 60 h

Unit I Fundamentals of Polymers and Their Processing 15h

Basic Concepts, classification, importance of polymers, monomers, initiators, inhibitors, retarders, techniques of polymerisation: mass, solution, suspension, emulsion and gas phase; control of molecular weight and their determination, step polymerisation, radical/chain polymerisation, living and non-living chain polymerisation, co-ordination polymerisation, co-polymerisation, ionic ploymerisation, ring opening polymerisation, introduction, compounding of plastics and rubber, type, nature and role of additives, pre- compounding operations, mixing of polymers and additives, compression molding, transfer, injection and blow molding, extrusion, calendering, thermoforming, roto-molding, casting, sintering and compaction, deep coating, mold design, analysis of defects in molded products.

Unit II Analytical Principles **15h**

Evaluation of analytical data: Accuracy and precision. Standard deviation, variance and coefficient of variation. Student 't' test. Confidence limits. Estimation of detection limits. Errors: Classification, distribution, propagation, causes and minimization of error. Significant figures and computation rules. Correlation analysis: Scatter diagram. Correlation coefficient, r. Calculation of r by the method of least squares.

Volumetric methods: Classification of reactions in volumetry. Theories of indicators: Acid-base, redox, adsorption, metallochromic, fluorescent and chemiluminescent indicators. Complexation titrations: Titrations using EDTA, NTA and Titriplex. Precipitation titrations. Redox titrations. Gravimetric methods: Mechanism of precipitate formation. Aging of precipitates. Precipitation from homogeneous solutions. Coprecipitation and postprecipitation. Contamination of precipitates. Washing, drying and ignition of precipitates. Organic reagents used in gravimetry: Oxine, dimethylglyoxime and cupferron.

Thermal methods of analysis: Principles and instrumentation of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC). Applications of thermal methods in analytical chemistry and in the study of minerals and polymers.

Unit III Science of Corrosion and Corrosion Control **15h**

Corrosion, theories of corrosion. Kinetics of corrosion, Evan's diagram, thermodynamics of corrosion-Pourbaix diagram. Forms of corrosion. Corrosion prevention: modification of materials, corrosion inhibitors, protective coatings, cathodic and anodic protection.

Corrosion testing techniques: Evaluation of corrosion effect- XRD, ESCA, FTIR and surface techniques Corrosion in industries with special reference to oil and mining industries.

Unit IV Electroanalytical Methods **15h**

Potentiometric methods: Reference electrodes and indicator electrodes. The hydrogen, calomel, Ag-AgCl electrodes. The glass electrode – its structure, performance and limitations. Measurement of pH. Petentiometric titrations. Redox and precipitation titrations. Electrogravimety: Principle and method. Determination of Cu. Separation of metals. Conductometry: Principle and method. Conductance measurements. Conductometric titrations. Coulometry: Principle and method. Coulometric titrations.

Text Book/Reference:

1. M.C.Day and j.Selbin, "Theoretical Inorganic Chemistry", Affiliated East-West Press
2. F.A.Cotton and G.Wilkinson, "Advanced Inorganic Chemistry, John Wiley & Sons
3. J.E.Huheey, "Inorganic Chemistry – Principles of Structure and Reactivity", Harper Collins College Publishers.
4. A.I.Vogel, "A Text Book of Quantitative Inorganic Anaysis", Longman

5. D.A.Skoog, D.M.West and F.J.Holler, "Fundamentals of Analytical chemistry", Saunders College Publishing.
6. W.W.Wendlandt, "Thermal Methods of Analysis", John Wiley & Sons
7. G.Friedlander and J.W.Kennady, "Introduction to Radiochemistry", John Wiley & Sons
8. Injection Moulds & Moulding, J.B Dym, Van Ronstrandt-Reinhold, New York, 1980.
9. Polymer Process Engineering, E.A Grulke, PTR Prentice Hall, Eaglewood Chiffs, New Jersey, 1994.
10. Principles of Polymer Engineering, N.G Mccrum, C.P Buckley & C.P Bucknell, Oxford Engineering Press, Oxford, 1988.
12. Extrusion of Plastics, E.G Fisher, Newness-Butterworth, London, 1976.
14. Principles of Polymer Processing, R.T. Fenner, Macmillan, London, 1979

APC-E XII (C) BIOORGANIC CHEMISTRY (CBCS) 60 h

UNIT-I Cell structure and metabolism 15h

Prokaryotic and eukaryotic cells; Intracellular organelles and their functions; Comparison of plant and animal cells; Metabolic processes – catabolism and anabolism; ATP – currency of biological energy; Energy-rich and energy-poor phosphates.

Carbohydrates

Structure and function of sugar derivatives (deoxy, amino, branched chain sugars); Polysaccharides of biological importance,dextran, sialic acid; Cell-cell recognition and
blood group substances.

UNIT-II Metabolic Reactions 15h

Fatty acid metabolism: Biological importance of fatty acidsand lipids, even chain and odd chain fatty acids, saturated and unsaturated fats, ketone bodies, fatty acid metabolism, calorific value of foods, bological membranes, properties and function of lipid bilayers and liposomes. Protein-related transformations: Amino acid degradation (C3, C4, C5family), urea cycle, uric acid and ammonia formation; Enzymatic hydrolysis of proteins to peptides; Amino acid sequencing; amino acid metabolism (biosynthesis and degradation).

UNIT-III Nucleic Acids 15h

Chemical and enzymatic hydrolysis of nucleic acids; Structure and function of mRNA, tRNA, rRNA; Polymorphic nature of DNA, B- and Z-DNA, multi-stranded DNA; DNA sequence determination by chemical and enzymatic methods, Genetic code – origin, salient features, wobble hypothesis; Gene expression – transcription and translation; Gene mutation and carcinogenesis

UNIT-IV Enzymes and Co-Enzymes 15h

(a) Co-enzyme chemistry: Cofactors derived from vitamins, coenzymes, prosthetic groups, apoenzymes; Structure & biological function ofcoenzyme A,

thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid and vitamin B12; Mechanisms of reactions catalyzed by above co-factors.

(b) Enzyme models: Host-guest chemistry, chiral recognition and catalysis, molecular

recognition, diometric chemistry, crown ether, cryptates; Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes.

Text Book/Reference:

1. Stryer, L. Biochemistry(4th edn.), W. H. Freeman & Co. (1995).
2. Zubay, S.. Biochemistry, Addison-Wesley (1983).
3. Sindell, R. P. DNA Structure and Function, Academic Press (1994).
4. Saenger, W. Principles of Nucleic Acid Structure, Springer-Verlag (1984).
5. Gringauz, A. Introduction to Medicinal Chemistry: How Drugs Act and Why? John Wiley & Sons (1997).
6. Dugas, H. & Penny, C. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Springer Verlag (1998).
7. Palmer, T. Understanding Enzymes, Prentice Hall (1995).
8. M.1. Page and A. Williams (eds.).Enzyme Mechanisms, Royal Society of Chemistry, (1987).
9. Price, N. C. & Stevens, L. Fundamentals of Enzymology, Oxford University Press (1989)
10. Trevan, M. D. Immobilized Enzymes: An Introduction and Applications Biotechnology, John Wiley (1980).
11. Fersht, A. & Freeman, W. H. Enzyme Structure and Mechanism, W.H. Freeman, New York (1985).
12. Metzler, D. E. Biochemistry: The Chemical Reactions of Living Cells, Academic Press (2001).

M. Sc. Part –II Semester III
Applied Chemistry Practical Course
(Practical No. AC-311 and AC-312)

Applied Inorganic Chemistry Practicals Ore Analysis - 3

1. Alloy Analysis - 3
2. Preparation of coordination complexes
3. Ion exchange study of separation of mixtures & estimations
4. Spectrophotometry
5. Separation & estimation of ions using ion exchange chromatography
6. Nephelometry
7. Potentiometry
8. Conductometry
9. Thermal analysis
10. Magnetic properties of transition metal complexes
11. Spectro Fluorimetry

12. Solvent extraction
13. Nuclear chemistry
14. Soil analysis
15. Data analysis

Text Book/Reference:

1. A.I.Vogel, "A Textbook of Quantitative Inorganic Anaysis", Longman
2. I.M.Kolthoff, V.J.Elving and Sandell, "Treatise on Analytical Chemistry", Interscience.
3. I.M.Kothoff and Strenger, "Volumetric Analysis", Interscience
4. Fruman and Welcher, "Standard Methods of Inorganic Analysis", Van Nostrand
5. G.Schwarzenback, "Complexomtric Titrations", Interscience
6. D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt.
7. W.G.Palmer, "Experimental Inorganic Chemistry", Cambridge University Press
8. R.S.Drago, "Physical Methods in Inorganic Chemistry", Affiliated East-West Press

M. Sc. Part –II Semester III
Applied Organic Chemistry Practicals

1. Preparation of organic compounds by multi-step reactions involving nitration, halogenation, acetylation anoxidation.

2. Estimation of ester, acids, reducing sugars, phenols, amines, ketones, nitrogen and sulphur.
3. Quantitiative analysis of (a) milk and butter, (b) fats, oils and soaps, (c) drugs such as acetyl salicylic acid, aspirin, phenacetin and suphanilide, (d) caffeine, sugar and starch food, (e) spectrophotometric determination of simple organic compounds, and (f) spectrophotometric determination of cholesterol, ascorbic acids, glucose and ammonia.
4. Characterization of organic compunds using IR, UV-Vis and NMR spectral methods.

Text Book/Reference:

1. A. I. Vogel, "A Textbook of Practical Organic Chemistry", Longman
2. A. I. Vogel, "Elementary Practical Organic Chemistry – Part 3: Quantitative Organic Analysis", Longman
3. F. G. Mann and B. C. Saunders, "Practical Organic Chemistry", Longman
4. B. B. Dey and M.V.Sitaraman, "Laboratory Manual of Organic Chemistry",
5. B. L. Oser (Ed), "Hawk's Physiological Chemistry", Tata McGraw-Hill
6. British Pharmacopoeia and Indian Pharmacopoeia,
7. A. C. Agarwala and R. M. Sharma (Eds), "A Laboratory Manual of Milk Inspection", Asia Publishing House

M. Sc. Part –II Semester III
Applied Physical Chemistry Practicals

Potentiometry

1. To determine instability constant & stiochiometry of silver ammonia complex potentimetrically.

2. Determination of Thermodynamic Parameters for electrochemical reactions. (To determine ΔG^o, ΔH^o,and ΔS^o for the formation of 1 mole cadmium in 1 wt. % amalgam at 25^o C and activity coefficient of solution).

Spectrophotometry

1) To determine pK value of methyl red indicator at room temperature spectrophotometrically

2) To determine stoichiometry & stability constant of ferric Sulphosalicylic acid/ salicylic acid complex by Job's Method and mole ratio method spectrophotometrically.

3) To dsetermine equilibrium constant of reaction $KI + I_2 \longrightarrow KI_3$ spectrophotometrically

Amperometry

To determine unknown concentration of Iodine using amperometry

Chemical Kinetics

To determine the order of reaction between acetone and iodine catalyzed by acid.

Conductometry

To determine equivalent conductance at infinite dilution of strong electrolytes and weak acid by using Kolharausch Law and dissociation constant for weak acid conductometrically.

Cryoscopy

To determine molecular weight and state of benzoic acid in benzene.

Moving boundary Method

To determine transport of H+ ions by using Moving boundary method.

pH - Metry

To determine dissociation constant of carbonic acid pH metrically.

Polarography

To determine half wave potential of a given ion using half height method, differential method and wave equation method

Latent heat of Fusion

Determination of latent heat of fusion of a given solid.

Thermochemistry

Determination of heats of dilution and integral heat of solutions.

Text Book/Reference:

1. A.Finlay and J.A.Kitchener, “Practical Physical Chemistry, Longman
2. F.Daniels and J.H.Mathews, “Experimental Physical Chemistry”, Longman
3. A.M.James, “Practical Physical Chemistry”, J.A.Churchil
4. H.H.Willard, L.L.Merritt and J.A.Dean, “Instrumental Methods of Analysis”, Affiliated East-West Press
5. D.P.Shoemaker and C.W.Garland, “Experimental Physical Chemistry”, McGraw-Hill
6. A.I.Vogel, “A Textbook of Quantitative Inorganic Chemistry”, Longman
7. J.B.Yadav, “Advanced Practical Chemistry”, Goel Publishing House
8. J.J.Lingane, “Electroanalytical Chemistry”, Interscience
9. L.Meites, H.C.Thomas and R.P.Bauman, “Advanced Analytical Chemistry McGraw Hill

M. Sc. Part –II Semester III

Applied Analytical Chemistry Practicals

1. Food Analysis
2. Cosmetics Analysis
3. Drug Analysis
4. Vitamin Analysis
5. Thermal Analysis of Inorganic Materials

Text Book/Reference:

1. A.I.Vogel, "A Textbook of Practical Organic Chemistry", Longman
2. A.I.Vogel, "Elementary Practical Organic Chemistry – Part 3: Quantitative Organic Analysis", Longman
3. F.G.Mann and B.C.Saunders, "Practical Organic Chemistry", Longman

SEMESTER IV
M. Sc. Part-II APPLIED CHEMISTRY

APC-C XIII APPLIED INORGANIC CHEMISTRY-II 60 h

Unit I a) Infrared and Raman Spectroscopy 09 h

Molecular vibrations, force constants, Molecular vibrations and absorption of Infrared radiations Raman Spectroscopy, polarized Raman lines, Use of symmetry considerations to determine the no. of lines in IR and Raman Spectra, Spectra of gases, applications of Raman and Infrared spectroscopy. Selection rule in Inorganic structure determinations, Hydrogen bonding and infrared spectra, metal ligand and related vibrations.

b) Microwave spectroscopy 06 h

Basic concept, rotation spectra of simple inorganic compounds, Classification of molecules, rigid rotor model, effect of isotopic substitution on transition frequencies & intensities non rigid rotor, stark effect nuclear and electron spin interaction and effect of external field. Applications of Micro wave Spectroscopy.

Unit II Magnetic Resonance Spectroscopy 15 h

Electron Spin Resonance Spectroscopy: ESR of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields; evaluation of g values and metal hyperfine coupling constants.

Nuclear Magnetic Resonance: Applications of 31P, 19F, 119Sn and 195Pt NMR spectroscopy in the structural assessment of inorganic compounds.

Unit III Instrumentation for Characterization of Inorganic Materials- I 15 h

a) Microscopy: Transmission Electron Microscopy [TEM]; High resolution Transmission Microscopy[HRTEM]; Scanning Electron Microscopy [SEM]; Scanning Tunneling Microscopy [STM]; Atomic Force Microscopy [AFM];

b) Spectrometric techniques: Atomic Absorption Spectroscopy (AAS); Raman Spectroscopy; Electron Spectroscopy for Chemical Analysis

Unit IV Instrumentation for Characterization of Inorganic Materials-II 15 h

a) Compositional Analysis tools: X-ray Diffraction (XRD); SIMS/MS; Auger Electron Spectroscopy

b) Superconducting Quantum Interface (SQUID) Maganetometry

c) Brunauer-Emmett-Teller Gas Absorption Surface Area Measurement and Pose Structure Analysis (BET Method)

Text Book/Reference:

1. K J Klabunde, Nanoscale materials in Chemistry, Wiley Interscience 2001
2. R W Cahan, The Coming of Material Science, Pergamon (2001)
3. A R West, Basic Inorganic Chemistry, II Ed, Jhon Wiley & Sons (1999)
4. U Schubest and N Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
5. David Thompson, Insight into Speciality Inorganic Chemicals, Royal Society of Chemistry (1988)
6. R. S. Drago, Physical Methods in Chemistry, Saunders College Publishers (1977).
7. C. N. Benwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata Mcgraw Hill, New Delhi (2006).

APC-C XIV APPLIED ORGANIC CHEMISTRY-II 60 h

Unit I Chemistry of Biopolymers 15 h

Amino acid: Introduction and Classification, Protection and deprotection of N-terminus and C-terminus of amino acids, Peptides and their synthesis. Solid phase peptide synthesis (SPPS),

Proteins: Structure and Classification, Chemistry of nucleic acid bases A.G.C.T and U and their synthesis, Structure of DNA. Structure of Starch, Cellulose Glycogen and Chitin.

Unit-II Pericyclic Reactions 15 h

Molecular orbital symmetry, Frontier orbitals of ethylene 1,3 butadiene, 1,3,5, hexatriene and allyl system, classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions – antarafacial and suprafacial addition ,4n and 4n+2 systems, 2+2 addition of ketenes, 1,3, dipolar cycloadditions. Sigmatropic rearrangements- suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3, and 5,5 sigmatropic rearrangements. Ene reaction.

Unit III Chemistry of Drugs & Pharmaceuticals 15 h

Classification of drugs based on activity. Synthetic procedure for the present commonly used drugs of each type, Manufacturing of few important drugs, Semi synthetic penicillin's. Vitamins: type of vitamins, synthesis of Vit – A and Vit – E,

Vitamine – II of niacinamide, Use of NMR in structure determination of drugs andpharmaceuticals: Instrumentation and Applications.

Unit IV Heterocycles **15 h**

Six membered Heterocycles with one heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones.

Six membered Heterocycles with two and more Heterocycles: Synthesis and reactions of diazines & triazines.

Seven membered Heterocycles: Synthesis and reactions of azepines, oxepines & thiepines.

Text Book/Reference:

1. Text Book of Polymer science, F.W.Billmeyers Jr Wiley
2. Polymer Science, V.R.Gowarikar, N. V. Vishwanathan and J Shreedhar, Wiley
3. Functional monomers and polymers, K. Takemote, Y Inkiand R m Ottanbrite.
4. contemporary Polymer Chemistry, H.R.Alcoek and F W Lambe, Practice Hall.
5. Physics and chemistry of polymers, J M G,Cowie, Blackie, Academic and Prfessinoal.
6. H.Arora, "Organic Photochemistry and Pericyclic Reactions"
7. Lendieer and Mitscher: The organic chemistry of drug synthesis (I.W)
8. Burger : Medicinal Chemistry.
9. A. Kar: Medicinal Chemistry (Wiley East)
10. W. O. Foye : Principals of medicinal chemistry.
11. Wilson, Gisvold & Dorque: Text book of organic medical and pharmaceutical chemistry
12. Pharmaceutical manufacturing encyclopedia.
13. R. M. Acheson : An introduction to chemistry of heterocyclic compounds (Interscience).
14. Joule & Smith : Heterocyclic chemistry (Van Nostrand).
15. R. K. Bansal: Heterocyclic chemistry (Wiley E).
16. L. A. Paquitte : Principals of modern heterocyclic chemistry.
17. M. H. Palamer : The structure and reactions of heterocyclic compounds.
18. A. R. Katritzky: Advances in Heterocyclic Chemistry (A.P.)
19. Finar: Organic chemistry (Vol. 1& 2)
20. Cohn & Stumpt : Outline of Biochemistry.
21. Williams : Introduction to the chemistry of enzyme action.
22. The Organic Chemistry of Drug design and Drug action, R. B. Silverman Academic press.
23. Strategies for Organic Drug synthesis and Design, D. Lednicer, J. Willey.

APC-C XV ADVANCED ORGANIC CHEMISTRY-II 60 h

Unit I Green Chemistry 15 h

Introduction to the principles of green chemistry – prevention of waste, atom economy, less hazardous chemical syntheses, designing safer chemicals, safer solvents and auxiliaries, design for energy efficiency, reduce derivatives, renewable feedstock, catalysis, design for degradation, real time analysis for pollution prevention, and inherently safer chemistry for accident prevention. Green synthesis, clean routes using supercritical solvents, ionic liquids and water.

Unit II a] Kinetic and thermodynamic control of reactions: 08h

Reactions of naphthalenene, Wittig reaction, enolization, Friedel-Crafts reactions, Diels Alder reaction, Addition of electrophiles to dienes.

b] Oxidation: 07h

Oxidation with Cr and Mn compounds: oxidation of alcohol, aldehyde, C=C, C-H bonds in organic molecules, Pyridinium chloro chromate (PCC), Oxidation with peracids and other peroxides: C=C, Sharpless epoxidation.

Other types: Prevost and Woodward hydroxylation, *cis*- and *trans*-hydroxylation, glycol cleavage reagent; HIO_4, $Pb(OAc)_4$, mercuric acetate; SeO_2, DDQ.

Unit III Chemistry of Natural Products 15 h

a] Structure and synthesis of alpha-Pinene, Camphor, Cadenine and Caryophyllene. Hofmann, Emde and von Braun degradation. Structure elucidation of Papaverine, Quinine and Morphine. Synthesis of Quinine and Papaverine. Structure and synthesis of beta-Carotene, Classification and structure of lipids and their biofunctions.

b] Prostaglandings: Nomenclature, structure (not elucidation) and biosynthesis of Prostaglandins PGE_2, and PGF_{1v}.

Unit IV Selected Organic Reactions and Reagents: 15 h

Lithium dimethyl cuprate, Dicyclohexyl carbodimide, Lithium diisopropylamine, 1,3–dithiane (reactivity umpolung), Trimethyl silyl iodide, Baker Yeast, Phase-transfer catalysts.

Text Book/Reference:

1. L.M.Harwood, “Polar Rearrangements”, Oxford University
2. J.March, “Advanced Organic Chemistry”, Wiley
3. S.N.Issacs, “Physical Organic Chemistry”, Longman
4. P.Y.Bruice, “Organic Chemistry”, Prentice Hall
5. H.Arora, “Organic Photochemistry and Pericyclic Reactions”
6. C.H.Dupuoy, and O.L.Chapman, “Molecular Reactions and Photochemistry”, Prentice Hall
7. J.M.Cozon and B.Holton, “Organic Photochemistry”, Cambridge University Press
8. S.H.Pine, “Organic Chemistry”, McGraw-Hill
9. I.L.Finar, “Organic Chemistry” Vol w, Longman

10. R.P.Wayne, "Principles and Applications of Photochemistry", Oxford University Press
11. J.Kagan, "Organic Photochemistry", Academic Press
12. R.J.Simmonds, "Chemistry of Biomolecules", Royal Society of Chemistry J.Mann and others, "Natural Products – Their Chemistry and biological significance", Longman
13. I.L.Finar, "Organic Chemistry" Vol 2, Longman
14. W.Kar, "Medicinal Chemistry", Wiley Eastern
15. Advanced Organic Chemistry, Reaction Mechanism and Structure, Jerry March, John Wiley.
16. Modern Synthetic Reaction, H.O. House, W.A. Benjamin.
17. Principles in Organic Synthesis, R.O.C. Norman and J.M. Coxon.
18. Reactions Mechanisms & Problems in Organic Chemistry, P Chattapadhyay,1st Edn, Asian Books Private Limitted, New Delhi
19. Organic Synthesis, Michael B Smith, McGraw Hill, 2nd Edn, 2004, New York.

*APC-E XVI [A] INORGANIC CHEMICAL INDUSTRIES 60 h

UNIT-I Special materials for electronic Industry 15h

Recent trends in sensor technology, Film sensors, Semiconductor IC technology, Microelectromechanical Systems (MEMS) Nanosensors.

Applications of Sensors: Automobile sensors, home appliance sensor, Aerospace sensors, Sensors for manufacturing medical diagnostic sensors, Sensors for environmental monitoring.

High purity Silicon, Germanium, Gallium Arsenide (GaAs) Indium phosphide (InP) etc. preparation using Zone refining, Crystal growth and there use in electronic industry.

High temperature materials, High alumina, alumina, SiC, Chromite, Zirconia, Magnesite etc.

Ionic & Superionic conductors, β alumina oxide ion conductors, halide conductors superionic, Fastion conductors- $RbbAg_4I_5$, Arrhenious equation.

UNIT-II Fertilizer Industries 15h

General Principles of plant Nutrition:

Essential plant nutrients, functions of the essential elements, classification of commercial nitrogenous fertilizers. manufacturing of ammonium sulphate, Urea, Ammonia nitrate Commercial phosphatic fertilizers. manufacturing process and properties of phosphatic fertilizers, single super phosphate, triple super phosphate.

Commercial potassic fertilizers:

Chemicals of potassium compounds, classification, manufacturing process and properties of potasium fertilizer, mariate of potassium, potassium sulphate, mixed fertilizer.

Micronutrients:

Role and deficiency symptom of micronutrients.

Biofertilizers:

classification, demands and production,Present status of fertilizer Industries in India.

UNIT-III Metal Finish Technology **15h**

Basics of electrodeposition, Electroplating principles and practice, Electrochemistry applied to electroplating, Electroplating of metals chromium, cadmium, nickel, copper, silver, gold, purpose of metalelectroplating composition and condition of plating bath, applications waste treatment and metal recovery.

UNIT-IV Glass & Ceramics, **15h**

Physical and chemical properties of glasses, Raw materials, manufacturing of special glasses.Ceramics and their properties, raw materials, manufacturing of ceramics, Applications of colours to pottery, use of ceramics.

Industrial Gases:

Manufacturing and industrial uses of H_2 O_2, N_2, CO_2, Cl_2 & acetylene gases. Liquefaction of gases, production of low temperature.

Chemicals of Utility:

Inorganic fine chemicals, magnesia, alumina, $AlCl_3$, calcium carbonate, sodium silicate, MnO_2, $FeSO_4$, PbO_2 and NaOH.

Text Book/Reference:

1. H. V. Keer, Principles of Solid state.
2. A. R. West, Solid State Chemistry and its applications, John Wiley & Sons, 2003.
3. B. K. Sharma, Engineering chemistry, Krishna Prakashan Media.
4. Lowenheim F A (1978) Electroplating MC Graw-Hill Book Company.
5. Gable, D: Principal of metal Treatment and protection. Pergaman, Press Oxford (1978)
6. G.A. Keneth: Electroplating for Engineering's A Hand Book IIIrd Edn Van Nastrad Reinbold Co London
7. F A Lowinbein: Modern Electroplating, Electroplating Publication New Jersey
8. Burke, Progess in ceramic science Vol. IV
9. R.R.Iash: afromulary of paints and other coating Vol. I
10. Industrial chemistry, B. K. Sharma.
11. Engineering chemistry, B. K. Sharma.
12. S. D. Shukla & G N Pandey: A text book of chemical technology Vol. 1
13. F A. Henglein: Chemical Technology (Pergamon)
14. D. Patranabis, Sensors and Transdusers, 2nd Ed^{n}, Prentice, Hall of India (2003).
15. Rajankumar Basak, Fertilizers, A text Book
16. R. Balsubramaniam, Materials Science and Engineering

* This paper is common with M. Sc. Part- II, Semester- IV Industrial Chemistry

APC-E XVI [B] POLLUTION MONITORING AND CONTROL 60 h

Unit – I a] Removal of Heavy Toxic Metals: **07 h**

Chromium, Mercury, Lead, Cadmium, Arsenic analytical methods of determination of small amounts of the metal pollutants, copper recovery, treatment of waste to remove heavy metals, recovery techniques.

b] Removal of Particulate Matter: 08 h

Particulate matter and dynamics of particles separations, Particulate matter in gas sream, filtering, gravity separation, liquid scrubbing cyclone separations, electrostatic precipitations safety of workers analysis of particulate matter.

Unit –II Removal of Phenolic Residue*:* 15 h

Sources of Phenolic residues, Analytical methods, treatment by using stream gas stripping, ion – exchange, solvent extraction, oxidation methods, Microbiological treatment General nature of Organic residue not mentioned so far. Role of Vapor pressure, role of solubility, effect of pH on solubility extractive methods of recovery and recycle, Chemical methods of conversion to less soluble nontoxic or biodegradable and products carcinogens, economics of and recycle methods. Incineration of no recyclable concentrates and residues.

Unit – III Removal of Sulphur Dioxide and Nitrogeneous Pollutants*:* 15 h

Origin of SO_2 and its hazard, Analysis of SO_2, SO_2 control methods, desulphurization of fuels, Indian cola and Indian Crude oil. Economics of SO_2 control measures NOx, dissolved NOx, nitrites, ammonia, Urea and other nitrogene containing compounds in the effluents fertilizer explosive, industrial effluents, effluents from nitro aromatic industries, analytical methodology, Photochemistry of air pollution.

Unit – IV a] Biotechnology in Chemical Industry: 10 h

Essential elements in biological system Mettallo – proteins and mettallo–enzymes. Metal ions as a charge carriers Health effects due to deficiency and excess of metals of non-metals Biotechnology for the production of chiral compounds. Role of biotechnology in Industry.

b] Polymer Recycling*:* 05 h

Environmental and polymer Industries. Recycling of polymers waste.

Text Book/Reference:

1. S.P. Mahajan: Pollution control in processes iIndustries (J.W)
2. P.N.Chennsioff and R. A Young: Air Pollution control and design Hand Book and recovery (J.W)
3. J.R. Holmes: Refuse recycling and recovering (J.W)
4. M. Sitting: Resources recovery and recycling Hand Book and Industrial Wastes (NDS)
5. J.O. Niagh: Sulphur in the Environment Vol. I & II (J.W)
6. P.S.Minor: The Industry/EPA controntation (MGH)
7. R.B.Pojaselc: Toxic and Hazardous waste disposal Vol. I &II (AAS)
8. S.M.Khopkar: environmental pollution analysis
9. A.K.Dey: Environmental Chemistry
10. W.Handley: Industrial safety Handbook
11. J.E.Huheey et. Al. Inorganic Chemistry, 1993
12. J.E.Huneey etal. (1993) Inorganic Chemistry.

APC-E XVI [C] APPLIED ANALYTICAL CHEMISTRY- II 60 h

Unit I Principle of Chemical Engineering 15 h

Introduction to chemical engineering. Comparison of academic and industrial Chemistry. Material and energy balances. Units and dimensions. Fluid mechanics. Fluid statistics. Benoulli equation. Flow measurements. Pipes, pipe fittings and valves. Heat transfer: Steady state heat conduction. Unsteady state heat conduction. Heat flow by convection. Heat exchagers and evaporators. Distillation: Vapout-liquid equlibrium. The fractionating column. Comparison of plate columns and packed columns. Mass transfer operations. Principles of extraction, leaching and absorption. Chemical reactions: Batch and continuous reactors. Concepts ofresidence time, space time and space velocity.

Unit II Pollution and its Control 15 h

Air pollution: Composition of air. Classification of pollutants. Sources of air pollutants. Industrial pollution: Power plats. Fertilizers. Petrochemicals. Automobile pollution. Water pollution: Water quality criteria for domestic and industrial uses. Analysis of waree and wastewater. Principles of water and wastewater treatments. Removal of organics and harmful inorganics from water and wastewater. Biological treatment of wastewater: Theory and practice. Sludge treatment and disposal.

Unit III Manufacturing of Organic Chemicals 15 h

Raw materials and routes to major organic products. Flwo sheets and engineering aspects of the manufacture of of important products such as nitrobenzene, linera alkyl enzene sulphonate, chlorobenzene vinyl chloride, DMT, ethyl acetate, cummene, alkyl benzenes, cyclohexanone, pthalic acid, soaps, detergents and hydogenation of oils. Pharmaceuticals: Manufacturing processes of aspirin, vitamin A and paracetamol. Pesticides: Manufacture of BHC, DDT, Carbaryl and Malathion. Manufacture of dyes.

Unit IV Manufacturing of Inorganic Heavy Chemicals 15 h

Introduction to chemical industry: Flow sheet preparation. Principles of process selection and operation selection. Basic raw materials and routes to major inorganic products. Flow sheets and engineering aspects of the manufacture of sulphuric acid, sodium hydroxide, chlorine, ammonia, phosphoric acid, nitric acid, ammonium nitrate, urea, glass, ceramics, refractories and Portland cement.

Text Book/Reference:

1. E.K.Rideal, “Concepts in catalysis”, Academic Press
2. A.Clark, “The Theory of Adsorption and Catalysis”, Academic Press
3. R.Pearce and W.R.Patterson (Eds.), “Catalysis and Chemical Processes.”,Backie and sons
4. J.M.Betty, “Applied Industrial Catalysis”, Academic Press
5. Coulson and Richardson, “Chemical Engineering”, Vol. 1,2, & 3
6. McCabe, “Unit Opeartion of Chemical Engineering”
7. Peter Wiseman, “Industrial Organic Chemistry”

8. N.R.Nerris Shreve, “Chemical Process Industries”
9. Dridens, “Outline of Chemical Technology”
10. B.K.Sharma, “Industrial Chemistry, Goel Publishing House

M. Sc. Part II Semester-IV
Applied Chemistry Practical Course
(Practicals No. APC-VII and APC-VIII)

Applied Inorganic Chemistry Practical

Ore analysis (Three)

1. preparation of coordination compounds(Three) and preparations of mixed metal oxides (two)
2. Ion exchange chromatography; separation of multicomponent mixtures
3. Solvent extraction
4. Spectrophotometry
5. pH Metry
6. Conductometry
7. Polarography
8. Electrogravimetry
9. Nuclear and radiochemistry

B) Interpretation exercises

1. X-ray powder diffraction analysis of cubic compound

a. Determination of lattice constants and geometry
b. Partical Size
c. Density

2. Interpretation of Mossbaur spectrum with reference to determination of a) isomer shift b) quadruple splitting c) Internal magnetic field d) general comment
3. Interpretation of IR spectrum with reference to stretching vibration 0-2 C=N, C=O, N-, M-O
4. Interpretation of NMR spectrum with reference to calculation of chemical shifts and general comments.
5. Interpretation of absorption spectra for

a. Verification of position of ligands in spectrochemical series.
b. Determination of gemetry (Octahedral, square planer, tetrahedral) of a given compound.
c. Calculation of spectral splitting parameters.

6. Interpretation of polar gram for determination of half wave potentials and unknown concentration.
7. Calculation of band gap of semiconductors with the help of plots of log & vs. 10 3/4.

In all 20 experiments with at least five expts in each course should be completed. Addition of new expts in place of existing one may be allowed. A veriety of small projects designed by by teacher based on the interest of ttu stule and capabilities should be worked out. Project work and the review report will be examined by internal and external examiners.

Text Book/Reference:

1. A.I.Vogel, "A Textbook of Quantitative Inorganic Anaysis", Longman
2. I.M.Kolthoff, V.J.Elving and Sandell, "Treatise on Analytical Chemistry", Interscience.
3. I.M.Kothoff and Strenger, "Volumetric Analysis", Interscience
4. Fruman and Welcher, "Standard Methods of Inorganic Analysis", Van Nostrand
5. G.Schwarzenback, "Complexomtric Titrations", Interscience
6. D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt.
7. W.G.Palmer, "Experimental Inorganic Chemistry", Cambridge University Press
8. R.S.Drago, "Physical Methods in Inorganic Chemistry", Affiliated East-West Press

M. Sc. Part II Semester-IV
Applied Organic Chemistry Practicals

Three stage preparations starting with 5g or less & TLC.

1. Estimation of sulphur, nitrogen and functional groups, pharmaceutical analysis.

2. Polyfunctional analysis

3. Organic preparations

1. Preparation of benzanilide by Beckmann rearrangement
2. Preparation of anthranilic acid
3. Preparation of phthalimide
4. Preparation of N- bromosuccinamide
5. Preparatin of p- Amino benzoic acid
6. Preparation of p- chloro nitrobenzene by Sandmeyer reaction
7. Preparation of p- Idonitrobenzene by Sandmeyer reaction
8. Pinacol- Pinacolone rearrangement

4. Any other experiments as may be necessary.

(Any other suitable experiments may be added)

Text Book/Reference:

1. A Textbook of Practical Organic Chemistry – A. I. Vogel.
2. Practical Organic Chemistry – Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes.
5. Organic Reactions (Wiley).

M. Sc Project/ Industrial Training/Review Articles:-[As a partial fulfillment of M Sc Applied Chemistry Course]

In the final semester, students have to carry out project work either at SU or in any R&D laboratory (Private, public and Government) Universities, Institutes of national repute across the country under the guidance of a Scientist or a Faulty member. The Area of the work is to be decided by the Adviser on completion of the Project work , students have to submit then work in the form of a dissertation followed by oral presentation in the presence of Faculty members and an external expert.

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 extinguishers (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.

Co-ordinator….