Dr. B.R.Ambedkar University, Srikakulam

General Regulations relating to
POST GRAUDATE AND PROFESSIONAL COURSES

Revised Syllabus for P.G. Courses with Choice Based Credit System (CBCS) for the academic year 2016-17

0. Candidates seeking admission for the Masters/Professional Degree Courses shall be required to have passed the qualifying examination prescribed for the course of any University recognized by Dr. B.R. Ambedkar University, Srikakulam as equivalent there to

1. The course and scope shall be as defined in the Scheme of Instruction and syllabus prescribed.

2. The course consists of 2/4/6 semesters, @ two semesters/year, unless otherwise specified.

3. The candidates shall be required to take an examination at the end of each semester of the study as detailed in the Scheme of Examination. Each semester theory paper carries a maximum of 100 marks, of which 85 marks shall be for semester-end theory examination of the paper of three hours duration and 15 marks shall be for internal assessment

4. (a) Internal Assessment for 15 Marks: Two mid-term exams, one conventional (descriptive) and the second – 'on-line' with multiple choice questions for each theory paper shall be conducted. The average of these two mid-term exams shall be taken as marks obtained for the paper under internal assessment. If any candidate appears for only one mid-term exam, the average mark, dividing by two shall be awarded. If any candidate fails to appear for both the mid term exams of a paper, only marks obtained in the theory paper shall be taken into consideration for declaring the result. Each mid-term exam shall be conducted only once.

4. (b) Candidates shall be declared to have passed each theory paper if he/she obtains not less than E Grade ie., an aggregate of 40 % of the total marks inclusive of semester-end and internal assessment marks in each paper.

5. A candidate appearing for the whole examination shall be declared to have passed the examination if he/she obtains a Semester Grade Point (SGP) of 5.0 and a CGPA of 5.0 to be declared to have passed the Course.

6. Not withstanding anything contained in the regulations, in the case of Project Report/Dissertation/ Practical/Field Work/Viva-voce etc., candidates shall obtain not less than D grade, i.e., 50% of marks to be declared to have passed the examination.
7. ATTENDANCE: Candidates shall put in attendance of not less than 75% of attendance, out of the total number of working periods in each semester. Only such candidates shall be allowed to appear for the semester-end examination.

7. (a) A candidate with attendance between 74.99% and 66.66% shall be allowed to appear for the semester-end examination and continue the next semester only on medical and other valid grounds, after paying the required condonation fee.

7. (b) In case of candidates who continuously absent for 10 days without prior permission on valid grounds, his/her name shall automatically be removed from the rolls.

7 (c) If a candidate represents the University at games, sports or other officially organized extra-curricular activities, it will be deemed that he/she has attended the college on the days/periods

8 Candidates who put in a minimum of 50% attendance shall also be permitted to continue for the next semester. However, such candidates have to re-study the semester course only after completion of the course period for which they are admitted. The candidate shall have to meet the course fees and other expenditure.

9 Candidates who have completed a semester course and have fulfilled the necessary attendance requirement shall be permitted to continue the next semester course irrespective of whether they have appeared or not at the semester-end examination, at their own cost.

Such candidates may be permitted to appear for the particular semester-end examination only in the following academic year; they should reregister/ reapply for the Semester examination.

The above procedure shall be followed for all the semesters

10. Candidates who appear and pass the examination in all the papers of each and every semester at first appearance only are eligible for the award of Medals/Prizes/Rank Certificates

11. BETTERMENT: Candidates declared to have passed the whole examination may reappear for the same examination to improve their SGPA, with the existing regulations without further attendance, paying examination and other fees. Such reappearance shall be permitted only with in 3 consecutive years from the date of first passing the final examination. Candidates who wish to appear thereafter should take the whole examination under the regulations then in vogue.

12. The semester-end examination shall be based on the question paper set by an external paper-setter and there shall be double valuation for post-Graduate courses. The concerned Department has to submit a panel of paper-setters and examiners approved by the BOS and the Vice-chancellor nominates the paper-setters and examiners from the panel.

13. In order to be eligible to be appointed as an internal examiner for the semester-end examination, a teacher shall have to put in at least three years of service. Relaxation of service can be exempted by the Vice-Chancellor in specific cases.

14. If the disparity between the marks awarded in the semester-end examination by internal and external examiners is 25% or less, the average marks shall be taken as the mark obtained in the paper. If the disparity happens to be more, the paper shall be referred to another examiner for third valuation. In cases of third valuation, of the marks obtained either in the first or second valuation marks, whichever is nearest to the third valuation marks are added for arriving at the average marks.

15. Candidates can seek revaluation of the scripts of the theory papers by paying the prescribed fee as per the rules and regulations in vogue.

16. The Project Report/Dissertation/ Practical/Field Work/Viva-voce etc shall have double valuation by internal and external examiners.

17. A Committee comprising of the HOD, one internal teacher by nomination on rotation and one external member, shall conduct viva-voce examination. The department has to submit the panel, and the Vice-chancellor nominates viva-voce Committee.

18. Grades and Grade Point Details (with effect from 2009-10 admitted batches)

S. No	Range of Marks	Grade	Grade Points
1.	> 85 %	O	10.0
2.	75 % – 84 %	A	9.0
3.	67 % - 74 %	B	8.0
4.	58 % - 66 %	C	7.0
5.	50 % - 57 %	D	6.0
6.	40 % - 49 %	E	5.0
7.	< 39 %	F (Fail)	0.0
8.	Incomplete: (Shall be upgraded from E to O Grade on subsequent appearance of the same semester. I The corresponding Grade Points will be awarded)		

19. Calculation of SGPA (Semester Grade Point Average) & CGPA (Cumulative Grade Point Average):

For example, if a student gets the grades in one semester A,A,B,B,B,D in six subjects having credits 2(S1), 4(S2), 4(S3), 4(S4), 4(S5), 2(S6), respectively. The SGPA is calculated as follows:

$$\text{SGPA} = \frac{\{9(A)x2(S1)+9(A)x4(S2)+8(B)x4(S3)+8(B)x4(S4)+8(B)x4(S5)+6(D)x2(S6)\}}{\{2(S1)+4(S2)+4(S3)+4(S4)+4(S5)+2(S6)\}} = \frac{162}{20} = 8.10$$

i. A student securing 'F' grade thereby securing 0.0 grade points has to appear and secure at least 'E' grade at the subsequent examination(s) in that subject.

ii. If a student gets the grades in another semester D, A, B, C, A, E, A, in seven subjects having credits 4(S1), 2(S2), 4(S3), 2(S4), 4(S5), 4(S6), 2(S7) respectively,

$$\text{SGPA} = \frac{\{6(D)x4(S1)+9(A)x2(S2)+8(B)x4(S3)+7(C)x2(S4)+9(A)x4(S5)+5(E)x4(S6)+9(A)x2(S7)\}}{\{4(S1)+2(S2)+4(S3)+2(S4)+4(S5)+4(S6)+2(S7)\}} = \frac{162}{22} = 7.36$$

$$\text{CGPA} = \frac{(9x2+9x4+8x4+8x4+6x2+6x4+9x2+8x4+7x2+9x4+5x4+9x2)}{(20+22)} = \frac{324}{42} = 7.71$$

a) A candidate has to secure a minimum of 5.0 SGPA for a pass in each semester in case of all PG and Professional Courses. Further, a candidate will be permitted to choose any paper(s) to appear for improvement in case the candidate fails to secure the minimum prescribed SGPA/CGPA to enable the candidate to pass at the end of any semester examination.

b) There will be no indication of pass/fail in the marks statement against each individual paper.

c) A candidate will be declared to have passed if a candidate secures 5.0 CGPA for all PG and Professional Courses.

d) The Classification of successful candidates is based on CGPA as follows:
   i) Distinction –CGPA 8.0 or more;
   ii) First Class –CGPA 6.5 or more but less than 8.0
   iii) Second Class –CGPA 5.5 or more but less than 6.5
   iv) Pass –CGPA 5.0 or more but less than 5.5

e) Improving CGPA for betterment of class will be continued as per the rules in vogue.

f) CGPA will be calculated from II Semester onwards up to the final semester. CGPA multiplied by “10” gives aggregate percentage of marks obtained by a candidate.

ANNEXURE – I

Eligibility

Course in	Qualifying Examination for Admission
M.Sc Analytical Chemistry	B.Sc Chemistry/Applied Chemistry(as main wherever applicable) as one of the subjects

ANNEXURE – II

M.Sc. ANALYTICAL CHEMISTRY

SCHEME OF INSTRUCTION

First Semester:

Course No.	Title of the Paper	Compulsory/Elective	No. of Periods of Instruction per Week
101	General Chemistry-I	Compulsory	6
102	Inorganic Chemistry-I	Compulsory	6
103	Organic Chemistry-I	Compulsory	6
104	Physical Chemistry-I	Compulsory	6
105	Lab-I: Inorganic Chemistry-I	Compulsory	12
106	Lab-II: Organic Chemistry-I	Compulsory	12
107	Lab-III: Physical Chemistry-I	Compulsory	12

Second Semester:

Course No.	Title of the Paper	Compulsory/Elective	No.of Periods of Instruction per Week
201	General Chemistry-II	Compulsory	6
202	Inorganic Chemistry-II	Compulsory	6
203	Organic Chemistry-II	Compulsory	6
204	Physical Chemistry-II	Compulsory	6
205	Lab-I: Inorganic Chemistry-II	Compulsory	12
206	Lab-II: Organic Chemistry-II	Compulsory	12
207	Lab-III: Physical Chemistry-II	Compulsory	12

Third Semester:

Course No.	Title of the Paper	Compulsory/Elective	No.of Periods of Instruction per Week
301	Separation Methods – I	Compulsory	6
302	Quality control and Traditional methods of Analysis-I	Compulsory	6
303	Applied Analysis-I	Compulsory	6
304	Spectroscopic Methods of Analysis	Compulsory	6
305	Lab-I: Multi stage organic synthesis and Chromatography techniques	Compulsory	12

Fourth Semester:

Course No.	Title of the Paper	Compulsory/Elective	No.of Periods of Instruction per Week
401	Separation Methods – II	Compulsory	6
402	Traditional Methods of Analysis - II	Compulsory	6
403:	Applied Analysis – II	Compulsory	6
404	Instrumental Methods of Analysis	Compulsory	6
405	Lab-II: Organic Mixture analysis and Estimations	Compulsory	12

Each candidate has to present a paper on chemistry and related topics, according to the schedule given by the Department for 20 Minutes on Saturday in the SEMINAR conducted by the Department.
During all the four semesters the medium of instruction and writing examination is ENGLISH only.

Annexure - III

Scheme of Examination as per Credit System

First Semester:

Course No.	Title of the Paper	Credit	Max. Marks.	Valuation (Internal/ External) uble	Internal assessment/ viva-voce and record
101	General chemistry-I	4	100	85	15
102	Inorganic chemistry-I	4	100	85	15
103	Organic chemistry-I	4	100	85	15
104	Physical chemistry-I	4	100	85	15
105	Lab I : Inorganic Chemistry-I	2	50	40	10
106	Lab II : Organic Chemistry-I	2	50	40	10
107	Lab-III: Physical Chemistry-I	2	50	40	10
Total		22	550	460	90

Second Semester:

Course No.	Title of the Paper	Credit	Max. Marks.	Evaluation (Internal +External)	Internal Assessment / viva-voce and record
201	General chemistry-II	4	100	85	15
202	Inorganic chemistry-II	4	100	85	15
203	Organic chemistry-II	4	100	85	15
204	Physical chemistry-II	4	100	85	15
205	Lab I : Inorganic Chemistry-II	2	50	40	10
206	Lab II : Organic Chemistry-II	2	50	40	10
207	Lab-III: Physical chemistry-II	2	50	40	10
Total		22	550	460	90

Third Semester:

Course No.	Title of the Paper	Credit	Max. Marks.	Double Valuation (Internal + External)	Internal Assessment / viva-voce and record
301	Separation Methods – I	4	100	85	15
302	Quality control and Traditional methods of Analysis-I	4	100	85	15
303	Applied Analysis-I	4	100	85	15
304	Spectroscopic Methods of Analysis	4	100	85	15
305	Lab-I: Multi stage organic synthesis and Chromatography techniques	6	150	125	25
Total		22	550	465	85

Fourth Semester:

Course No.	Title of the Paper	Credit	Max. Marks.	Double Valuation (Internal + External)	nternal Assessment/ iva-voce and record
401	Separation Methods – II	4	100	85	15
402	Traditional Methods of Analysis - II	4	100	85	15
403	Applied Analysis – II	4	100	85	15
404	Instrumental Methods of Analysis	4	100	85	15
405	Lab-II: Organic Mixture analysis and Estimations	6	150	125	25
		22	550	465	85

Total Marks: - First, Second, Third & Fourth Semesters put together: 550+550+550+550 =2200

Total Credits: - First, Second, Third & Fourth Semesters put together: 22+22+22+22 = 88

Dr. B.R. AMBEDKAR UNIVERSITY –SRIKAKULAM
SYLLABUS - M.Sc. ANALYTICAL CHEMISTRY

I SEMESTER

COURSE-101: GENERAL CHEMISTRY-I

Unit I:

Wave equation – interpretation of wave; function – properties of wave function – normalization and orthogonalisation, Operators – Linear and non-linear-commutators of operator.

Unit II

Postulates of quantum mechanics, setting up of operators observables – Hermitian operator – Eiger values of Hermitian operator.

Wave mechanics of simple systems with constant potential energy, particle in one dimensional box – factors influencing colour-transition-dipole integral, Symmetry arguments in deriving the selection rules – the concept of tunneling

Unit III:

Particle; in a three dimensional box, Rigid rotor, Wave mechanics of systems with variable potential energy-simple harmonic oscillator-solution of waves equation – selection rules.

Unit IV:

Rotational spectra of diatomic ;molecules – Rigid rotor-Selection Rules-Calculation of bond length-isotopic effect, Second order start effect and its applications, Infrared spectra of diatomic molecules-harmonic and anharmonic oscillators- Selection rules-overtones-combination bands- Calculation of force constant, anharmonicity constant and zero point energy. Fermi resonance, Simultaneous vibration-rotation spectra of diatomic molecules.

UNIT V:

Raman effect-Classical and quantum mechanical explanations-Rotational Raman and Vibrational Raman spectra, Electronic spectra of diatomic molecules-Vibrational coarse structure-intensity of spectral lines-Franck Condon principle-applications, Rotational fine structure-band head and band shading, Charge transfer spectra.

Reference Books :

1.Quantum chemistry V edition by Iran . levine 2000 by pearson education
2. Quantum chemistry IV edition by A.K Chandra TataMcgrawHill publishing 1994
3. Fundenatals of molecular spectroscopy IV edition by colin N Banwell and Elaine M. Mc cash, Tata Mc graw Hill publishing.

I SEMESTER
COURSE-102: INORGANIC CHEMISTRY-I

UNIT – I:

Chemical Bonding: Application of VB, MO and VSEPR theories in
Explaining the structures of simple molecules – role of 'P' and'd' orbital in
$\prod$ - bonding.

UNIT – II:

Chemistry of main group elements: General trends in properties – Boron hydrides, carboranes, intercalation compounds – nitrogen – phosphorous,
Boron – nitrogen and sulphur – nitrogen cyclic compounds.

UNIT – III:

Coordination compounds: Crystal field theory – Crystal field splitting patterns in Octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries – Determination of crystal field splitting energy – calculation of crystal field stabilization energies –

UNIT IV

Factors affecting crystal field splitting energies – spectrochemical series – Jahn – Teller effect – Ligand field theory.

Term symbols – Russell – Saunders coupling – derivation of term symbols for various configurations.

UNIT – V:

Electronic Spectra of transition metal complexes – selection rules-break down of selection rules – Orgel and Tanabe Sugano diagrams

Magnetic properties of free ions – spin and orbital moments and spin – orbit coupling – quenching of orbital momentum by crystal fields in complexes.

Reference Books:

1. Advanced inorganic chemistry by F.A. Cotton and R.G. Wilkinson, IV Edition, Johnwiley and sons, Newyork, 1980.
2. Inorganic Chemistry by J.E. Huhey, III edition, Harper International Edition, 1983.
3. Theoretical Inorganic Chemistry II edition by M.C. Day and J. Selbin, Affiliated – East – West press Pvt, Ltd., New Delhi
4. Cocncise inorganic chemistry IV edition by J.D.Lee Black well publications, 1996

Course- 105: Inorganic Chemistry –I LAB I

Inorganic Qualitative analysis

Books suggested: Vogels text book of Inorganic qualitative analysis, pearson education.

I SEMESTER
COURSE-103: ORGANIC CHEMISTRY-I

UNIT – I

Structure and reactivity: Localised and delocalized convalent bond-Concept of reasonance and aromaticity-Huckel's rule for aromaticity in benzenold and non-benzenold compounds, anti-armaticity and ho,o-aromaticity. Nature of reaction energy and kinetic considerations – types of organic reactions – reagents – reactive intermediates. Their formation and stabilization – inductive and mesomeric effects.

UNIT – II

Stereochemistry and stereoisomerism. Conformational isomerism and analysis in acyclic and analysis in acyclic and simple ;cyclic systems – substituted ethanes, cyclopentane, cyclohexane cyclhexance, cyclo reactane and decalins, optical isomerism –optical activity molscular dissymmetry and chirality – elements of symmetry.

UNIT III

Fisher's projection D.L. and R.S. configurations – relative and absolute configurations optical isomerism due to asymmetric carbon atoms – optical isomerism in biphenyls, allenes and spirans - optical isomerism of nitrogenous compounds racemisation and resolution – geometrical isomerism and E,Z configurations, properties of geometrical isomers.

UNIT IV

Pyridne, quivoline, Isoquinoline, Indole, Benzofuran, Benzothiophene – Pyrodazine, immidazole, oxazole, Isoxazole, Thiazole, Isothiazole, Pyrizine and pyrazine.

UNIT – V: Chemistry of some typical natural products. A study of the following compounds involving their isolation, structure elucidation synthesis and biogenesis – flavonoids – quercetin, cyanding and genestein, terpeniods – terpeneol – pinene, amplhor, farnesol.

Text Books:

1. Organic Chemistry Vol. I (6^{th} Edition) and Vol. II (5^{th} Edition) by IL fial ELBS.

2. Organic Chemistry (5^{th} Edition) by Morrison and Boyd, PHI, India.

3. Organic Chemistry (5^{th} Edition) by Francis A. Carey Tata Mc Graw Hill publishing company Limited, New Delhi.

4. Reaction Mechanism in Organic Chemistry by Mukherjee Singh, Macmillian, India.

5. A guide book to mechanism in Organic Chemistry by pater Sykes, ELBS.

REFERENCE BOOKS:

Advanced Organic Chemistry by Jerry March (4^{th} Edition) wiley Basis.

Chemistry of Natural Products, K.W. Bent by stereochemistry of carton by E.Eliel, John willey & Sons, Inc.

Stereochemistry of Organic compounds by D. Nasipun.

Chemistry of Natural products by P.S. Kalsi Kalyani publishers, 1983.

Course- 106: ORGANIC CHEMISTRY- I LAB II

1. Part A: Synthesis of six organic compounds involving one or two stages.

Books Suggested for Practicals:

Vogels text book of Practical Organic chemistry,V th edition by B.S.Furniss,A.J.Hanna ford, P.W.G. Smith and A.R.Tatchell, Pearson Education,1989

I SEMESTER

COURSE-104: PHYSICAL CHEMISTRY-I

UNIT I:

States of matter: Transport properties of Gases – Thermal Conductivity – Viscosity-Diffusion. Theories of liquid structure; Calculation of Collision numbers.

UNIT II

Solids : X-Ray diffraction studies: Bragg's equation – Crystal structure determination; lattice type and lattice dimensions – crystal Defects – Band theory of solids – Semiconductors – Theories of Specific heats of solids.

UNIT III:

Thermodynamics: Free energy, entropy and enthalpy – chemical equilibrium – Thermodynamic criteria of the chemical equilibrium – Effect; of temperatures on equilibrium constant – Vant Hoff isochore Maxwell relations – Gibbs-Duhem equation; Duhem-margules equations. Classius-Clapeyron equations–Nernst heat theorem; Third law of thermodynamics and determination of absolute entropy – Limitation of third law of thermodynamics.

UNIT IV:

Kinetics I: Theories of reaction rates – collision theory – limitation; transitation state theory – effect of ionic strength – Debye – Huckle theory – primary and secondary salt effects – effect of dielectric constant of solvent-ion-ion interaction; solvent models – Born-Abharam, Langevin dipole model.

UNIT V:

Kinetics II: Effect of substituent – Hamett equation – limitations – Taft equation – prediction of rate constant of a reaction; consective reactions, parallel reactions, opposing reactions (unimolecular steps only – no derivation) specific and general acid-basic catalysis – Skrabal diagram – fast reactions – flow systems – temperature and pressure jump methods – relaxation.

Reference Books:

1. Physical chemistry volumes 2nd edition by K.L.Kapoor Published by Macmillan 2005.
2. Physical chemistry, Gilbert W.Castellan 3rdedition Published by Narosa publishing house.
3. Thermodynamics for chemists by Samuel Glasstone Published by Litton educational publishing.
4. Physical Chemistry 7th edition, 2002 by Atkins and paule Published by Oxford University press.
5. Kinetics and Mechanisms of chemical transformations, J Raja ram, J C Kuriacose, Published by Macmillan India Ltd.

Course- 107: PHYSICAL CHEMISTRY-I LAB III

1. Critical Solution Temperature of partially misciple liquids – Phenol – Water System.
2. Effect of electrolyte (NaCl) on Miscibility temperature.
3. Determination of cell constant.
4. Determination of pka value of acetic acid by Conductometric method.
5. Conductometric Titration of a strong acid with strong Bade (HCl vs NaOH).
6. Conductometric Titration of a weak acid with strong Base (ACOH vs NaOH).

BOOKS SUGGESTED:

1. Practical Experiments in Physical Chemistry by Alaxender Finllay.
2. Experiments in Chemistry by D.V. Jajargordam., Himalaya Publishing House, 2003
3. Physical Chemistry experiments by P. Ghosh.

M.Sc. Analytical Chemistry Syllabus
II SEMESTER
COURSE-201: GENERAL CHEMISTRY-II

UNIT I:

Hydrogen atom-solution of R (r), θ (θ) and Ø (ø) equations-probability density in orbital-shapes of orbital. Perturbation theory-time independent Perturbation (only first order perturbation is to be dealt with) - application to ground state energy of helium atom

UNIT II

Variation principle – applications – calculation of zero point energy of harmonic oscillator – many electron atom – Hartee – Fock self – consistent field method (qualitative treatment only). Valence bond approach – directed valance – hybridization

UNIT III:

Covalent bond – calculation of ionic and covalent bond contributions in hydrogen molecule. Molecular orbital theory – LCAO approximation – hydrogen molecule ion – hydrogen molecule (fundamental concepts only) – the electronic transitions in the hydrogen molecule.

MOLECULAR SYMMETRY AND GROUP THEORY:
UNIT IV

Basic concepts of Symmetry and group theory - Symmetry elements, Symmetry operations and point groups - Schoenflies symbols - Classification of molecules into point groups - Axioms of group theory – group multiplication tables for C_{2V} and C_{3V} Point groups – Similarity Transformation and classes – Representations – reducible and irreducible representations, Milliken symbols, Orthogonality theorem and its implications, Character table and its anatomy

UNIT V: ELEMENTS OF COMPUTER PROGRAMMING:

Basic components of computers, higher and lower level languages, Microsoft Fortran : Constants, variables and operators, arithmetic expression, assignment and replacement statement, Input and Output statements – Format free and format directed I/O statements –Iw, Fw.d, Ew.d and Gw.d format specifications, conditional and unconditional statements. Logical IF, Block IF and GO TO statements, DO statement – syntax and rules. Applications to chemical problems: Flow charts and Programs

Reference Books:

1. Quantum chemistry V edition by Iran. levine 2000 by pearson education
2. Quantum chemistry IV edition by A.K Chandra TataMcgrawHill publishing 1994
3. Chemical applications of group theory by F. Albert cottonpublished by Johan wily and sons.
4. FORTRAN 77 by V.Rajaraman, Published by Prentic – Hall of India Ltd.

II SEMESTER

COURSE-202: INORGANIC CHEMISTRY-II

UNIT I:

Chemistry of Transition elements: Comparative study of the first second and third transition series. Metal cluster compounds favorable conditions for their formation – structure and bonding in the following halied and carboxylate metal – cluster compounds.

$Re_2Cl_8^{2-}$, $Mo_2Cl_8^{4-}$, $Re_2(RCOO)_4X_2$, $Mo_2(RCOO)_4(H_2O)_2$,
$Cr_2(RCOO)_4(H_2O)_2$, $Cu_2(RCOO)_4(H_2O)_2$, $Cr_2Cl_9^{3-}$, $Mo_2Cl_9^{3-}$, $W_2Cl_9^{3-}$, Re_3Cl_9, $Re_3Cl_{12}^{3-}$, $Mo_6Cl_8^{4+}$, $Nb_6X_{12}^{2+}$ and $Ta_6X_{12}^{2+}$

UNIT II:

Chemistry of Inner Transition elements: Chemistry of Lanthanides electronic configurations – oxidation states – lanthanide contraction and its consequences-magnetic and special properties – separation of lanthanides.

Chemistry of actinides : - synthesis of Tran uranium elements, electronic configurations, oxidation states, position in the periodic table – actinide contraction – comparison of magnetic and spectral properties of actinides with those of lanthanides .

UNIT III:

Metal Ligand Equilibria in solution: Stepwise and overall formation constants, trends in stepwise constants factors affecting the stability of metal complexes – chelate effect – Determination of stability constants of complexes – Spectrophotometric method and P^H – metric method.

UNIT IV:

Inorganic Reaction Mechanisms: Inert and labile complexes-Explanation of lability on the basis of CFSE. Substitution reactions of metal complexes – D, Id, Ia and A mechanisms – ligand replacement reactions of octahedral, complexes

UNITV:

Acid Hydrolysis, Anation and base hydrolysis of cobalt (III) Complexes – ligand displacement reaction of square plants, complexes of platinum (II) – trans affect mechanism of trans effect (Theories) – Electron transfer reactions of complexes – Inner and outer sphere mechanisms.

BOOKS: In addition to the books mentioned under Inorganic Chemistry Paper – I syllabus, the following are suggested.

1. Chemistry of Lanthanides by T.Moeller, Chapman and Hall
2. Man-made Transuranium elements by G.T.Seaborg.
3. Mechanisms of Inorganic Reactions in solution by D.Benson. MC graw Hill. London, 1968.

COURSE-205: Inorganic Chemistry –II LAB I

Inorganic Quantitative analysis.

Books suggested: Vogels Inorganic qualitative analysis, pearson education

II SEMESTER

COURSE-203: ORGANIC CHEMISTRY- II

UNIT I:

Aromatic substitution reactions – electrophilic, nucleophilic and through benzynes – redical substitution of arenes – orientation of nucleophilic substitution at a saturated carbon, SN_1, SN_2, SN_i reactions – effect of structure, nucleophile, leaving group, solvent. Additions involving elctrophiles, nucleophiles and free radicals.

UNIT II

Elimination reactions – E_1, $E1_{CB}$, E2 reactions – elimination versus substitution reactions. Ene – reaction, Benzoin Condensation, Stork enamine reactions

UNIT III

Mechanism of some name reactions: Aldol, Perkin, Cannizaro, Wittig, Grignard, Reformatsky – Meerwein, Hoffmann Claisen and Favorsk, rearrangements. Hydroboration – openauer oxidation, clemmensen reduction – Meeraein pondorf and verley and Birch reductions. , Michael addition, Mannich Reaction, Diels – Alder reaction, , Bayer – Villiger Reaction.

UNIT IV:

Spectra and structure application of organic spectroscopy, UV, IR, HNMR and Mass spectral data.

UNIT V:

Isolation, structure elucidation and synthesis of alkaloids; atropine, nicotine, and Quinine. Purines – Caffeine configuration and ring structures of glucose and fructose, anomeric effects.

Text Books:

1. Organic Chemistry Vol. (Sixth Edn) and Vol. II (Fifth Ed,.) by it finar ELBS.
2. Organic Chemistry (fifth Edn.,) by Morrison and Boyd, PHL., India
3. Organic Chemistry fifth adition by Francis A. Carey Tata Mc Graw Hill publishing company Limited, New Delhi.
4. Reaction Mechanism in Organic Chemistry by Mukherjee Singh, Macmillan, India.
5. A guide book to mechanism in Organic Chemistry by peter Sykes, ELBS

REFERENCE BOOKS:

Advanced organic chemistry by Jerry March (4^{th} Edition) Wiley Eastern.
Chemistry of Natural Products, K.W.Bentley by stereochemistry of carbon compounds by E.Eliel, John Wiley & Sons,Inc.
Stereochemistry of Organic compounds by D.Nasipuri.
Chemistry of Natural Products by P.S.Kalsi Kalyani Publishers. 1983.

COURSE-206: ORGANIC CHEMISTRY-II LAB-II

1. PART B: Functional group identification (one or two functional groups) of organic compounds and preparation of its derivatives (at least two) .

Books suggested:

Vogels text book of Practical Organic chemistry,V th edition by B.S.Furniss,A.J.Hanna ford, P.W.G. Smith and A.R.Tatchell, Pearson Education,1989

II SEMESTER

COURSE-204: PHYSICAL CHEMISTRY- II

Physical methods of moleciles structure elucidation

UNIT I:

Magnetic properties of molecules – theories Of molecule magnetic susceptibility – measurement of magnetic structure susceptibility – Principle and theory of NMR elucidation spectroscopy – Nature of spinning particle and its interaction with magnetic field

UNIT II

chemical shift and its Origin – spin- spin interaction – experimental methods – applications of NMR studies in structural elucidation – structure of ethanol, dimethyl formamide, styrene and acetophenone.

UNIT III

Electron spin Principle and experimental technique – g-factor; Resonance: line shapes and line width – hyperfine interactions

applications of ESR studies to the structure of free radicals. Metal complexes and biological systems.

UNIT IV

Photochemistry : Fluorescence – delayed fluorescence; E(osine) and P (yrin) type phosphorescence Jabanowski diagram , photo physical process – intersystem crossing or internal conversion, derivation of Stern-Volmer equation – Quantum yield Quenching effect – Photo chemical equilibrium.

UNIT V

Electrochemistry: Electrochemical cell – Galvanic and electrolytic cell concentration cell with and without transference – effect of complexation on redox potential – ferricyanide/ferrocyanide couple: Iron(III) phenanthroline/Iron(II) phenantroline Couple: Determination of standard potential-activity coefficients from EMF data.

Reference Books

1. Fundenatals of molecular spectroscopy IV edition by colin N Banwall and Elaine M. Mc cash, Tata Mc graw Hill publishing

.2. Physical Chemistry 7^{th} edition, 2002 by Atkins and paule Published by Oxford University press.

3. Physical chemistry volumes 2^{nd} edition by K.L.Kapoor Published by Macmillan 2005.

4. An introduction to electrochemistry by Samuel Glasstone 1942, Letton educational publishing

5.Fundamentals of photochemistry by K.K. Rohatgi Mukherjee, New age international publishers ,1986

COURSE-207: PHYSICAL CHEMISTRY- II LAB-III

1. Determination of Composition of Cuprammonium Cation.
2. Determination of Equilibrium Constant of the reaction : $KI + I_2 = KI_3$.
3. Conductometric Titration of mixture of a strong acid and weak acid with a strong Base (HCL + ACOH) vs NaOH.
4. Potentiometric Titration of iron (II) with K2Cr2O7.
5. Determination of relative strength of acids (HCl) by Ester Hydrolysis.
6. Polarimetric Determination of relative strength acids by hydrolysis of sucrose.

BOOKS SUGGESTED:

1. Practical Experiments in Physical Chemistry by Alaxender Finllay.
2. Experiments in Chemistry by D.V. Jajargordam., Himalaya Publishing House, 2003
3. Physical Chemistry experiments by P. Ghosh.

M.Sc. Analytical Chemistry Syllabus
III Semester
Paper - 301: Separation Methods – I

Unit – I Chromatography - 1

Chromatography: classification of different chromatographic methods, methods of development-Elution development, Gradient elution development, displacement development, and frontal analysis.

Principles of chromatography, different migration, adsorption phenomena, partition, adsorption coefficient, retardation factor, retention time and volume, column capacity, temperature effects, partition isotherm.

Dynamics of chromatography-efficiency of chromatographic column, zone spreading, High Equivalent Theoretical Plate (HETP), Van Deempter equation, resolution, choice of column, length and flow velocity, qualitative and quantitative analysis.

Unit - II Chromatography – 2

(a) Column chromatography (adsorption chromatography): principles, general aspects, adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications.

(b) Gel Exclusion chromatography or Gel filtration chromatography: principles, properties of xerogels, apparatus and detectors, resolution of gel type, applications to organic compounds.

Unit - III Chromatography – 3

(a) Capillary Electrophoresis: Principle, Details of the Instrument, Applications to Inorganic and Organic compounds.

(b Inorganic molecular sieves: structure of zeolites, crystals, types of sieves, application in the separation of gases including hydrocarbons, ion exclusion-principles and applications, Counter current chromatography-principles and application, Affinity chromatography- principles and applications.

(c) Liquid-liquid partition chromatography: principle supports, partitioning liquids, eluents, reverse phase chromatography, apparatus, and applications.

Unit – IV: Chromatography – 4

(a) Gas chromatography: Theory, Instrument description of equipment and different parts, columns (packed and capillary columns), detector specifications-thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector, programmed temperature gas chromatography; applications in the analysis of gases, petroleum products etc., other detectors used their Principles and Applications.

(b) GC-MS – Introduction
Instrumentation – GC – MS interface – Mass spectrometer (MS)
Instrument operation, processing GC – MS data – ion chromatogram
Library searching – Quantitative measurement – sample preparation
Selected ion monitoring – Application of GC-MS for Trace constituents.
Drugs analysis, Environmental analysis and others.

Unit – V Chromatography – 5

(a) High performance liquid chromatography: Theory, Instrument description of the different parts of the equipment, columns, detectors-UV detector, refractometric detector, Fluorescence detector, Diode Array detector, applications in the separation of organic compounds, names of other detectors used their Principles and Applications.

(b) LC-MS – Introduction – Instrumentation – liquid chromatograph – Mass spectrometer Interface – Instrumental details – Processing LC-MS data – ion chromatograms – Library searching – Quantitative measurements.

Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples and others.

Text books:

1. R.P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
2. Separation methods, M.N Sastri, Himalaya Publishing Company, Mumbai

Reference books:

1. E. Helfman, Chromatography, Van Nostrand, Reinhold, New York
2. E. Lederer and M. Lederer, Chromatography, Elsevier, Amsterdam.
3. Chemical separation methods, John A Dean, Von Nostrand Reinhold, New York
4. R.P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
5. H.M Mc Nair and J.M.Miller, Basic Gas Chromatography, John Wiley, New York
6. W.Jeumings, Analytical Gas chromatography, Academic Press, New York
7. H. Eugelhardt (ed), Practice of HPLC, Springer Verrag, Berrin

III Semester

Paper- 302: Quality control and Traditional methods of Analysis-I

Unit – I Quality control

(a) Characteristics of an analysis: quality of an analytical procedure, limit of detection, sensitivity, safety, cost measurability, selectivity and specificity, quality control-principles of Ruggedness test, control charts, Youden plot, and ranking test.

(b) Evaluation and reliability of analytical data: limitation of analytical methods, accuracy, precision, errors in chemical analysis, classification of errors, minimization of errors, significant figures, computations and propagation of errors.

(c) Statistical analysis: Mean deviation, Standard deviation, coefficient of variance, normal distribution, F test, T test, rejection of results, presentation of data.

Unit – II Quality assurance

(a) Development and validation of an analytical method, units, concentrations, calculations, standards, chemical reactions, expressions of concentrations, importance of separation methods with examples.

(b) Quality assurance and management systems: elements of quality assurance, quality assurance in design, development, production and services, quality and quantity management system, ISO 9000 and ISO 14000 series-meaning of quality, quality process model, customer requirement of quality calibration and testing, statistical process control, process control tools, control chart, statistical quality control, acceptance sampling.

Good laboratory practices (GLP) – need for GLP, GLP implementation and organization, GLP status in India.

(c) Brief out line of ICH guide lines on drug substances and products.

Unit – III Decomposition techniques in analysis

(a) Inorganic Compounds

Principle of decomposition and Dissolution. Difference between dissolution / decomposition of Organic and Inorganic substances.

Importance of Decomposition Techniques in Analysis.

Principle of Dissolution of an inorganic substance.

Decomposition of samples with acids – H_2O, HCl, HF, HNO_3, H_2SO_4 and $HClO_4$ Decomposition of samples by fusion, Principle and with two examples each Alkali Fusion--- Na_2CO_3, NaOH,

Acidic Fusion--- Sodium Hydro Sulphate, Sodium Pyro Sulphate

Oxidation Fusion---Na_2O_2, Sodium Chlorate

Reductive Fusion $Na_2CO_3 + Na_4BO_4$

What is Sintering process, How is it different from Fusion. Fusion with alkali carbonates, alkali hydroxides, Sodium Peroxide

Decomposition of samples by sintering with sodium peroxide, sodium carbonate.

Principles of decomposition at high temperatures, high pressures .

Principles of Microwave and ultrasonic decomposition techniques.

(b) Organic Compounds

Principles of solubility of organic compounds, non polar, polar solvents.

Recrystallisation methods and application of solubility and Recrystallisation.

Unit – IV Oxidant systems – Principles and applications in analysis

Analytical chemistry of some selected oxidant systems – formal, standard and normal potentials in various media, species responsible for the oxidation properties, stability of the solutions, standardization, requirement for the selections of the oxidants, selection of suitable indicators for Oxidant systems.

a) Inorganic Systems Mn (III), Mn (VII), Ce (IV), Cr (VI), V (V), periodate, iodate,

b) Organic Systems chloramine-T.

Unit – V Organic Functional group analysis

Classification of functional groups with suitable examples.
Determination of:

1) Functional groups imparting acidic nature – thiol, enediol, phenolic hydroxyl.
2) Functional groups imparting basic nature – Aliphatic and Aromatic primary, secondary and tertiary amines – hydrazine derivatives.
3) Functional groups which impart neither acidic nor basic nature – Aldehydes, Ketones, Nitro, Methoxy, Olifinic.

Text books:

1. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
2. Chemical Separation and measurements – D.G Peterseti, John M.Haves Sanders Co.
3. Chemical analysis – H.A Laitinan, Mc Graw Hill Book Co.
4. Newer redox titrants – Berka, Zyka and Vulterin, Pergamon Press
5. Volumetric Analysis, Vol III – I.M Kolthoff and R.Belvher, Interscience Public, New York
6. Vogel's Text Book of Inorganic Quantitative Analysis – J.Bassett et al, ELBS
7. Organic functional groups – S.Siggia

Reference Books:

1. D.A Skoog, D.M West and F.J Holler, Analytical Chemistry, An Introduction, Sanders College Publishing, New York
2. K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series, Environmental Management
3. Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York
4. Quality Assurance in Analytical Chemistry – G.Kateman and F.W Pijpers, John Wiley and Sons, New York
5. Quantitative Chemical Analysis – I.M Kolthoff, E.B Sandel, E.J Meehan, S. Bruckenstein, Macmillan Company, London
6. Decomposition Techniques in Inorganic Analysis – J.Dolezal, P.Povondra, Z.Sulcek

III Semester

Paper – 303: Applied Analysis-I

Unit – I Analysis of Ores

(a) General techniques of analysis applied to complex materials - Scope of metallurgical analysis - General methods of dissolution of complex materials - Various chemical methods for the effective separation of the constituents in the complex materials.

(b) Analysis of ores: Iron ore- Analysis of the Constituents – Moisture , loss of ignition, Total Iron, ferrous Iron ,Ferric Iron, alumina , silica, Titania, Lime, Magnesia, Sulphur, phosphrous, manganese, alkalies, combined water, Carbon in blast furnace, flue dust and sinter.

(c) Manganese Ore - Analysis of the Constituents – Total Manganese, MnO_2, SiO_2, BaO. Fe_2O_3,Al_2O_3, CaO, P and S

(d) Chromite Ore - Analysis of the Constituents – Chromium, SiO_2, FeO, Al_2O_3 CaO,& MgO.

(e) Phosphate Ore - Analysis of the Constituents - CaO,P_2O_5, F, SiO_2,CO_2,S, Na_2O, Al_2O_3, Fe_2O_3, Mgo,K_2O,Cl,MnO. Organic carbon, Moisture, Loss of ignition.

(f) Aluminium Ore (Bauxite) - Analysis of the Constituents – Silica, Alumina, Fe_2O_3,Titania, MnO, P_2O_5, CaO, MgO, vanadium, zirconium, and alkalies.

Unit – II Analysis of Finished Products – I

(a) Analysis of steel for C, Si ,S, P, Mn, Ni, Cr; Mg and analysis of blast furnace slag .

(b) Analysis of refractory materials: fire clay, flour spar, and magnesite

(c) Analysis of fluxes - limestone and dolomite.

Unit – III Analysis of Finished Products – II

(a) Chemical Analysis of cement-silica, NH_4OH group, ferric oxide, alumina, lime, magnesia, Sulphide Sulphur , K_2O,Na_2O, free CaO in Cement and Clinker,SO_3 and loss on ignition.

(b) Analysis of oils - saponification number, iodine number, and acid number..

(c) Analysis of soaps - moisture, volatile matter, total alkali, total fatty matter, free caustic alkali or free fatty acids, sodium silicate , chloride.

(d) Analysis of paints-vehicle and pigment, $BaSO_4$,total lead and lead chromate

Unit – IV Assessment of water Quality-1

Sources of water, classification of water for different uses, types of water pollutants and their effects, Analytical methods for the determination of an ions in water:
CO_3^{2-}, HCO_3^-, F^-, Cl^-, SO_4^{2-}, PO_4^{3-}, NO_3^-, NO_2^-, CN^-, S^{2-}

Unit – V Assessment of water Quality-2

Analytical methods for the determination of cations in water:

Fe^{2+}, Fe^{3+}, Ca^{2+}, Mg^{2+}, Cr^{3+}, As^{5+}, Pb^{2+}, Hg^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Co^{2+}

Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water.

Text books

1. Handbook of Analytical Control of Iron and Steel Production, Harrison John, Weily 1979
2. Standard methods of Chemical Analysis, Welcher
3. Technical Methods of Analysis, Griffin, Mc Graw Hill
4. Commercial Methods of Analysis, Foster Dee Sneel and Frank M. Griffin, Mc Graw Hill Book Co.
5. Water Pollution, Lalude, Mc Graw Hill
6. Environmental Chemistry, Anil Kumar De, Wiley Eastern Ltd.
7. Environmental Analysis, S.M Khopkar (IIT Bombay)

III Semester

Paper - 304 Spectroscopic Methods of Analysis

Unit – I : Spectroscopic Methods - 1

(a) UV-Visible Spectroscopy: laws of absorption, deviation from Beer's law, single and double beam spectrophotometers-instrumentation, sources of radiation, detectors, qualitative analysis by absorption measurements, general precautions in colorimetric determinations, determination of certain metal ions by using ligands – Fe^{2+}, Fe^{3+}, Al^{3+}, NH^{4+}, Cr^{3+}, Cr^{6+}, Co^{3+}, Cu^{2+}, Ni^{2+} and anions – NO_2^-, PO_4^{3-} using suitable reagents, simultaneous determinations of dichromate and permanganate in a mixture, spectrophotomeric titrations, principle of diode array spectrophotometers.

(b) Spectrofluorimetry: Theory of fluorescence, phosphorescence, factors affecting the above, quenching, relation between intensity of fluorescence and concentration, instrumentation, application with reference to Al^{3+}, chromium salts, fluorescence, thiamin (B1) and riboflavin (B2) in drug samples.

Unit – II : Spectroscopic Methods - 2

(a) Infrared spectroscopy: units of frequency, wavelength and wave number molecular vibrations, factors influencing vibrational frequencies, instrumentation, sampling techniques, detectors, characteristic frequencies of organic molecules, qualitative and quantitative analysis with reference to (petroleum refinery and polymer industry), selected molecules like CO, CO_2, non-destructive IR method for the analysis of CO and other organic compounds, principles of Fourier transform IR.

(b) Raman Spectroscopy: Raman effect and spectra, differences between Raman spectra and IR spectra, instrumentation, Raman spectra of CO, CO_2, N_2O, H_2O.

Unit – III : Spectroscopic Methods -3

NMR Spectroscopy: resonance condition, origin of NMR spectra, instrumentation, chemical shift, factors affecting chemical shift, shielding, spin-spin splitting, mechanism for spin-spin coupling, interpretation of NMR spectra of typical organic compounds, factors influencing NMR spectra, fast chemical reactions, magnitude of I, nuclei with quadrupole moments, FT NMR, study of isotopes other than proton-^{13}C, ^{15}N, ^{19}F, ^{31}P, ^{11}B, double resonance, spin tickling, shift reagents, applications.

Unit – IV : Spectroscopic Methods -4

Mass Spectroscopy: principle, basic instrumentation, energetics of ion formation, types of peaks observed, resolution, qualitative analysis, molecular weight determination, quantitative analysis, advantages

.

Unit – V : Spectroscopic Methods -5

(a) ESR Spectroscopy: principle, g value, hyper fine splitting, qualitative analysis, Krammers degeneracy, fine splitting, instrumentation, introduction to double resonance technique, difference between ESR and NMR, quantitative analysis, application to study of free radicals and other analytical applications.

(b) X-ray Spectroscopy (XRF): chemical analysis by X-ray spectrometers, energy dispersive and wavelength dispersive techniques, evaluation methods, instrumentation, matrix effects, applications

Text Books:

1. Instrumental methods of analysis – H.H Willard, Meritt Jr. and J.A Dean
2. Principles of instrumental analysis – Skoog and West
3. Vogels Textbook of Quantitative Inorganic analysis – J. Basset, R.C Denney, G.H Jefferey and J.Madhan
4. Instrumental methods of analysis – B.K Sarma, Goel Publishing House, Meerut
5. Instrumental methods of Analysis – Chatwal and Anand
6. Instrumental methods of Analysis – Ewing
7. Handbook of ICP
8. The ICP – Bogdain B.

Reference Books:

1. Applications of ICP-MS, A.R Date and A.L Glay, London (Eds), Blackie, London
2. A. Moutaser and D.W Gologhtly (Eds), ICP in Analytical Atomic Spectrometry, VeH Publishers, New York
3. G.I Moore, Introduction to ICP emission Spectrometry in Analytical Spectroscopy, Elsevier, Amsterdam

M.Sc Analytical Chemistry
Syllabus
IV Semester
Paper-401: Separation Methods – II

Unit – I Chromatography - 6

(a) Paper chromatography: principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications.

(b) Thin layer chromatography: principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromatoplate, types of development, visualization methods, documentation, applications in the separation, HPTLC-principle, technique, applications.

Unit – II Chromatography - 7

(a) Ion Exchange: principles of ion-exchange systems, synthetic ion-exchange resins, properties of anion and cation exchange resins, ion-exchange mechanism, ion-exchange equilibria, selectivity, ion-exchange capacity, applications of ion-exchangers in different fields.

(b) Ion exchange chromatography: Principle, Equipment, Application Specifically Separations of Lanthanides, Actinides, amino acids.

(c) Ion chromatography: principles of separation, instrumentation, detectors, separation of cations and anions, applications in the analysis of water and air pollutants.

Unit – III Sampling Methods - 1

Sampling: Basis of sampling, purpose of sampling, homogeneous and heterogeneous samples, statistical criteria for good sampling, sample size, sampling unit, gross sample, laboratory sample. Sampling of Solids: Cone and Quartering method, Long pile and alternative shovel method, precautions in preservation of solid samples, sampling of metals and other solids rods, wires, sheets, plates, especially Gold, Silver, Iron and other metals.

Unit – IV Sampling Methods - 2

Sampling of different types of liquids: different sampling techniques, sampling of drinking water, industrial effluents, precautions in sampling and preservation of collected liquid samples.

Sampling of gases: sampling and Preconcentration by adsorption or absorption method, instantaneous monitoring, sampling in samplers and subsequent monitoring, different types of gas samplers, precautions in preservation of samples, systematic sampling and random sampling.

Unit – V Importance of Analytical chemistry & Solvent Extraction

(a) Importance of Analytical Chemistry to Industrial Research: Importance of Qualitative and Quantitative analysis in research and development, industries and other branches of science.

(b) Solvent Extraction: principles and processes of solvent extraction, Distribution Law and Partition coefficient, nature of partition forces, different types of solvent extraction systems – Batch extraction, Continuous extraction, Counter current extraction, solvent extraction systems, applications in metallurgy, general applications in analysis and pre-concentration, special extraction systems like crown ethers, super fluid and surfactant extractions-examples.

Text books:

1. R.P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
2. Separation methods, M.N Sastri, Himalaya Publishing Company, Mumbai

Reference books:

1. E. Helfman, Chromatography, Van Nostrand, Reinhold, New York
2. E. Lederer and M. Lederer, Chromatography, Elsevier, Amsterdam.
3. Chemical separation methods, John A Dean, Von Nostrand Reinhold, New York
4. R.P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
5. E.Stahl, Thin layer chromatography, Academic Press, New York
6. James, G.Tartor (Ion chromatography)

IVSemester

Paper –402 Traditional Methods of Analysis - II

Unit – I Precipitation methods - 1

(a) Crystal habit and super saturation, nucleation and crystal growth, homogeneous and heterogeneous nucleation, solubility and particle size, colloids, completeness of precipitation , effect of excess precipitant, pH, complex formation, temperature, purity of precipitates, aging.

(b) Co-precipitation and post precipitation : theory of adsorption of salts having an ion in common with the main precipitate, co-precipitation in colloidal precipitates, adsorption of solvents, mixed crystal formation by occlusion and entrapment, re-precipitation with examples, Post-precipitation – theory of post-precipitation, examples of post-precipitation, conditions for obtaining pure and quantitative precipitates..

Unit – II Precipitation methods - 2

(a) Precipitation from Homogeneous Solution (PFHS): theory of PFHS, methods of PFHS – increase in pH, decrease in pH, cation release, anion release, reagent synthesis, change in oxidation state, photochemical reactions, precipitation from mixed solvents. Applications of PFHS methods.

(b)Gravimetric determinations: nature of species, preparation of solutions, limitations, interferences, inorganic precipitants-chloride and sulphate, organic precipitants-dimethyl glyoxime (DMG), oxine, benzidine, salicylaldoxime, benzoin oxime, sodium tetraphenyl boron, tetraphenyl arsonium chloride.

Unit – III Precipitation methods - 3

(a) Precipitation Titrations: Principle, Indicators for precipitation titrations, determination of halides

(c) Electro-gravimetric analysis: principle, important terms in electrogravimetry, decomposition voltage or decomposition potential, over voltage and their importance, instrumentation, electrolysis at constant current, determination of Cu^{2+} by constant current electrolysis, electrolysis at controlled potentials, determination of Cu, Pb, Sn in brass and bronze by controlled potential electrolysis.

Unit – IV Reductant system – Principles and applications in analysis

Analytical chemistry of some selected reductant systems – formal, standard and normal potentials in various media, stability of the solutions, species responsible for the reduction properties, standardization, requirement for the selection of the reductants, selection of suitable indicators for various reductant systems,

(a) Inorganic Systems – Cr (II), V (II), Ti (III), Sn (II), Fe (II) in H_3PO_4 and hydrazine,
(b) Organic Systems – hydroquinone and Ascorbic acid.

Unit – V Analysis of some selected Drugs:

Basic considerations of drugs – Classification
Determination of the following Drugs:

1) Actyl salicylic acid (Antipyretic – Analgesic)
2) Testosterone, progesterone and cortisone (Steroids and corticoids)
3) Sulphadiazine (sulphadrugs)
4) Phenobarbitone (Barbituric acid derivatives)
5) Chloramphenicol, Benzyl penicillin and Tetracycline (Antibiotics)
6) Thiamine (B1), Riboflavin (B2) and ascorbic acid (c) [Vitamins]
7) Isoniazid (Antimicrobacterial agents)
8) Methlydopa (Antihypertensive agents)
9) Metronidazole (Antiamoebic agents).

Text books:

1. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
2. Chemical Separation and measurements – D.G Peterseti, John M.Haves Sanders Co.
3. Chemical analysis – H.A Laitinan, Mc Graw Hill Book Co.
4. Newer redox titrants – Berka, Zyka and Vulterin, Pergamon Press
5. Volumetric Analysis, Vol III – I.M Kolthoff and R.Belvher, Interscience Public, New York
6. Vogel's Text Book of norganic Quantitative Analysis – J.Bassett et al, ELBS
7. Pharmaceutical analysis – T. Higuchi, Brochmann hausfen

Reference Books:

1. D.A Skoog, D.M West and F.J Holler, Analytical Chemistry, An Introduction, Sanders College Publishing, New York
2. Quantitative Chemical Analysis – I.M Kolthoff, E.B Sandel, E.J Meehan, S. Bruckenstein, Macmillan Company, London

IV Semester
Paper – 403: Applied Analysis – II

Unit – I Analysis of raw materials

(a) Analysis of non-ferrous alloys:
  (i) Brass – Analysis of the constituents – Cu, Zn, Sn, Pb and Fe.
  (ii) Bronze - Analysis of the constituents – Cu, Sn, Zn, Pb and Fe.
  (iii) Solder - Analysis of the constituents – Sn, Pb and Sb.

(b) Analysis of Ferro alloys :
  (i) Ferro silicon - Analysis of the constituents – Si, C, P,S
  (ii) Ferro vanadium - Analysis of the constituents – V, C, P, S. Si, Al.
  (iii) Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si
  (iv) Silico manganese -Analysis of the constituents – Mn, S, C, P, Si
  (v) Ferro chromium - Analysis of the constituents – Cr, C, Si.

Unit – II Analysis of Soil, Fertilizer and Fuel

(a) Analysis of soils: sampling, determination of moisture, total N, P, Si, lime, humus nitrogen, alkali salts, soil absorption ratio.

(b) Analysis of fertilizers: ammonical fertilizers, Phosphate fertilizers, Nitrate fertilizers.

(c) Analysis of fuels: solid fuels-coal, proximate analysis, ultimate analysis, heating value, grading of coal based on Ultimate Heat Value(UHV).

Unit – III Assessment of Air Quality -1

Composition of pure air, classification of air pollutants, toxic elements present in dust and their sources – collection of air samples.

Sources, effects, control of pollution and chemical analysis for the following.

(a) Primary pollutants:
  (i) Carbon compounds - Carbon monoxide(CO) and Carbon dioxide(CO_2).
  (ii) Sulphur compounds- sulphur dioxide (SO_2), Sulphur trioxide (SO_3) and Hydrogen Sulphide (H2S).
  (iii) Nitrogen compounds - nitric oxide (NO),and nitrogen dioxide (NO_2),

Unit – IV Assessment of Air Quality - 2

(a) Analysis of the pollutants in ambient air and industrial stacks
  (i) Hydrocarbons - Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH).
  (ii) Particulate matter - Respirable and Suspended particulate matter, Inorganic and Organic particulates.

(b) Secondary pollutants - ozone (O_3), peroxy acetyl nitrate (PAN), peroxy benzyl nitrate (PBN)

(c) Standards for ambient air quality.

Unit- V Kinetic Methods of Analysis & Non aqueous Titrimetry

(a) Kinetic methods of analysis: introduction, slow reactions, catalyzed reactions, methods of determination of catalyst concentration, extrapolation method for the determination of catalyst, variable time method, fixed time method, examples for the determination of toxic metals and anions using some typical kinetic reactions.

(b) Non aqueous titrimetry : Classification of solvents and titrations for non aqueous titrmetry-Types of reactions - Indicators .
  (i) Determination of acids
  (ii) Determination of bases
  (iii) Karl-Fisher reagent for the determination of moisture content in drugs and other samples.

Text books

1. Chemical analysis – H.A Laitinan, Mc Graw Hill Book Co
2. Standard methods of Chemical Analysis, Welcher
3. Technical Methods of Analysis, Griffin, Mc Graw Hill
4. Commercial Methods of Analysis, Foster Dee Sneel and Frank M. Griffin, Mc Graw Hill Book Co.
5. Environmental Chemistry, Anil Kumar De, Wiley Eastern Ltd.
6. Environmental Analysis, S.M Khopkar (IIT Bombay)
7. Environmental Air Analysis, Trivedi and Kudesia, Akashdeep Pub.

IV Semester

Paper - 404: Instrumental Methods of Analysis

Unit – I: Spectroanalytical Methods of Analysis - 1

(a)Flame photometry: theory, instrumentation, combustion flames, detectors, and analysis of Na, K, Ca, Mg

(b)Atomic Absorption Spectrometer: theory, instrumentation, flame and non-flame techniques, resonance line sources, hollow cathode lamp, instrumentation, chemical and spectral interferences, applications with special reference to analysis of trace metals in oils, alloys and toxic metals in drinking water and effluents

Unit – II: Spectroanalytical Methods of Analysis - 2

(a)Inductively coupled plasma spectrometer(ICP-AES, ICP-MS): principles, instrumentation, plasma, AES detectors, quadrupole mass spectrometers, difference between the two detectors, analysis methods for liquids and solids, applications in the analysis of trace and toxic metals in water, geological and industrial samples.

(b) Arc and Spark spectrographic Direct analysis of solid for metals.

Unit – III Thermal methods of Analysis

(a) Thermo gravimetry-theory, instrumentation, applications with special reference to $CuSO_4.5H_2O$, $CaC_2O_4.2H_2O$, $CaCO_3$, $(COOH)_2.2H_2O$

(b) Differential thermal analysis-principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals, coals (fuels)

(c) Differential scanning calorimetry-principle, instrumentation, applications to inorganic materials like chlorates and per chlorates, ammonium nitrate.
Organic compounds and Drugs.

Unit- IV : Electro analytical Methods of Analysis - 1

(a) Voltametry and polarographic analysis : principle of polarography, residual current, migration current, diffusion current, half-wave potential, Ilkovic equation, instrumentation, Dropping mercury electrode (DME), advantages and disadvantages of DME, qualitative and quantitative analysis of inorganic ions-Cu, Bi, Pb, Cd, Zn, AC polarography, pulse polarography

(b) Anode stripping voltametry: principle, instrumentation, Hanging mercury drop electrode, application in the analysis of Pb and Cd in environmental samples, principle of cathode stripping voltametry.

(c) Coulometric analysis: principles of coulometric analysis with constant current, coulometric analysis with controlled potential, applications of coulometric methods for the analysis of cations-As (III), Fe (II) and I^- and S^{2-} by using I_2 liberations and Ce^{4+} liberation in solutions

Unit – V Electro Analytical and Radio chemical methods of analysis - 2

(a) Ion Selective Electrodes: reference electrodes - hydrogen electrode, calomel electrode, silver chloride electrode; indicator electrodes – hydrogen and glass electrodes, theory of membrane potentials and liquid junction potentials, types of ion selective electrodes, basic properties, potentials and construction, calibration of ion selective electrodes, ion selective electrodes with fixed membrane sites, silver, lead, cadmium, sulfide, fluoride, cyanide and glass electrodes, applications in the analysis of air and water pollutants, principles of liquid membrane, gas sensing and enzyme based electrode

(b) Radio chemical methods of analysis: detection and measurement of radioactivity, introduction to radioactive tracers, applications of tracer technique, isotope dilution analysis - applications, activation analysis – application, advantages and disadvantages, radio carbon dating technique

Text Books:

1. Instrumental methods of analysis – H.H Willard, Meritt Jr. and J.A Dean
2. Principles of instrumental analysis – Skoog and West
3. Vogels Textbook of Quantitative Inorganic analysis – J. Basset, R.C Denney, G.H Jefferey and J.Madhan
4. Instrumental methods of analysis – B.K Sarma, Goel Publishing House, Meerut
5. Instrumental methods of Analysis – Chatwal and Anand
6. Instrumental methods of Analysis – Ewing

Reference Books:

W.Wendtlandt, Thermal Analysis, John Wiley Sons, New York

Syllabus for Practicals

305 Lab-I: Multi stage organic synthesis and Chromatography techniques

PRACTICAL – I (CLASSICAL METHODS OF ANALYSIS)

1. Water analysis

(i) analysis of water for total hardness (Ca^{2+} and Mg^{2+})
(ii) analysis of water for chloride (Cl^-)
(iii) analysis of water for alkalinity (CO_3^{2-}, HCO_3^-)
(iv) analysis of dissolved oxygen (DO) in drinking water and sewage water
(v) analysis of chemical oxygen demand (COD) in drinking water and sewage water

2. Fertilizer analysis

(i) analysis of fertilizer for ammonia, nitrate and phosphate

3. Analysis of iron ore

(i) complete analysis of iron ore
(ii) analysis of iron ore (with special reference to percentages of Fe (II) and Fe (III) present in the sample)

4. Complexometric titrations

(i) analysis of zinc in zinc ore by using EDTA
(ii) analysis of nickel by EDTA
(iii) analysis of limestone or dolamite

5. Analysis of oils, fats and soaps

(i) analysis of oil for the determination of saponification value, acid value and iodine value
(ii) analysis of soaps for moisture content and total alkali

6. Analysis of coal

(i) moisture content
(ii) volatile matter
(iii) fixed carbon
(iv) ash content

DEMONSTRATION EXPERIMENTS

Practical – I

1. Determination of ion-exchange capacity of a given anion or cation exchange resin
2. Separation of a mixture of indicators using TLC
3. Separation of a mixture of carbohydrates using paper chromatography
4. Separation of a mixture of Cu, Ni, Zn and Mn by paper chromatography
5. Determination of BOD of water
6. Analysis of coal – moisture content, volatile organic carbon, ash content

Syllabus for Practicals

405: Lab-II: Organic Mixture analysis and Estimations

PRACTICAL – II (INSTRUMENTAL METHODS OF ANALYSIS)

1. pH metry

(i) Determination of alkalinity in a colored effluent using pH metric end point
(ii) Determination of purity of commercial HCl, H_2SO_4, H_3PO_4 and CH_3COOH using pH metric end point

2. Conductometry

(i) Determination of a mixture of strong acid and weak acid present in a colored effluent

3. Potentiometry

(i) Determination of Cr (VI) with Fe (II) using potentiometric end point
(ii) Determination of a mixture of Ce (IV) and V (V) with Fe (II) using potentiometric end point
(iii) Determination of a mixture of Mn (VII) and V (V) with Fe (II) using potentiometric end point
(iv) Determination of a mixture of bromide and chloride with $AgNO_3$ using potentiometric end point
(v) Determination of KSCN with $AgNO_3$ using potentiometric end point

4. Spectrophotometry

(i) Determination of Fe (III) using KSCN
(ii) Determination of nitrite in drinking water samples
(iii) Determination of phosphate in fertilizer
(iv) Simultaneous Determination of Cr (VI) and Mn (VII) in a mixture without separation

5. Flame photometry
Determination of Na, K, and Li

DEMONSTRATION EXPERIMENTS

Practical – II

1. NMR

   (a) Demonstration of NMR spectrometer and study of hydrogen bonding in a given alcohol or phenol
   (b) Interpretation of NMR chemical shifts of ethyl benzene, ethyl alcohol

2. IR – Interpretation of IR spectrum of alcohols, ketones, aldehydes and other standard materials

3. TGA, DTA, DSC – Demonstration of TG, DTA and DSC and study of decomposition of calcium oxalate, calcium carbonate, copper sulfate, oxalic acid

4. AAS and Flame photometry

   Demonstration of AAS – Determination of Zn, Cd, Pb, Mn, Fe and Ni in effluents using AAS.

5. Spectrofluorimetry – estimation of quinine and fluoroscene

6. Ion selective electrodes – estimation of F^-, S^{2-} and CN^- in effluents using ion selective electrode meter.

7. Polarography and Anode stripping voltametry

   (a) Polarography and Anode stripping voltametry – behavior of Cd, Zn, Pb in a mixture.
   (b) Determination of Pb and Cd in samples using Anode stripping voltametry

8. X-ray fluorescence – analysis of C, P, Ni, Cr and Mn in steel samples.

9. Atomic emission spectrometer (Quantometer) – analysis of C, S and P in pig iron and steel samples.

MODEL QUESTION PAPER

M.A /M.Sc/M.Com/MCA/MLISc/M.Ed/B.Ed(MR)/DEGREE EXAMINATIONS

COURSE IN: _____

SEMESTER_____

PAPER No._____ & TITLE: _____

TIME: 3 Hrs Max Marks: 85

SECTION – A

Question No.1 is Compulsory

Answer ALL questions

Each answer shall not exceed one page or 200 words

1. (5 x 5 = 25) A.

B.

C.

D.

E.

SECTION – B

Answer ALL questions

Each answer shall not exceed five page or 1000 words

(5 x 12 = 60)

UNIT-I

2.

Or

3.

UNIT-II

4.

Or

5.

UNIT-III

6.

Or

7.

UNIT-IV

8.

Or

9.

UNIT-V

10.

Or

11.