BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE (INDIA)

MASTER OF SCIENCE (ANALYTICAL CHEMISTRY)

M.Sc.-II (ANALYTICAL CHEMISTRY)

SEMESTER-III & IV

[CBCS- 2018 Course]

STRUCTURE OF M. Sc. II (ANALYTICAL CHEMISTRY)

COURSE NO.	COURSE NAME	CREDITS
SEMESTER- III		
PGAC 301	Thermal, Radio and Electro-analytical methods	4 Credits
PGAC 302	Modern aspects of Analytical Chemistry	4 Credits
PGAC 303	Recent Analytical Techniques-I	4 Credits
PGAC 304	Analysis of Pharmaceuticals	4 Credits
PGSEC 305	Assessment of Water Quality	2 Credits
SEMESTER-IV		
PGAC 401	Recent Separation Techniques	4 Credits
PGAC 402	Recent Analytical Techniques-I	4 Credits
# **Elective Paper (Any One from PGOC-403 to PGOC-405)**		
PGAC 403	Environmental Analysis	3+1 Credits
PGAC-404	Computer Interface with Chemistry	3+1 Credits
PGAC-405	Recent Methods of Analysis	3+1 Credits
Lab Course / Practicals*		
PGAC 407	Practical Course -I	2 Credits
PGAC 408	Practical Course -II	2 Credits
PGAC 409	Practical Course –III OR Project Work	2 Credits

***University examination for the practical courses PGOC-407, PGOC-408, PGOC-409 will be conducted at the end of the year.

Core Elective Course includes Core: Elective subjects and Industrial project.
Industrial Project includes one day visit, Internet survey, project writing, presentation or oral and be evaluated as the internal marks for Core: Elective Course (PGAC-403, PGAC-404, PGAC-405).

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGAC- 301 : THERMAL, RADIO AND ELECTROANALYTICALMETHODS

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1) Introduction to Electroanalytical methods:

A) Classical polarography:
Principles, construction and working of DME, polarographic wave, Factors affecting the wave, role of supporting electrolyte, maxima suppressor and N_2 flushing, Applications.

B) Advancements in polarography:
Electrodes, excitation signals, DC polarography pulse and differential pulse polarography, square wave polarography.

2) Voltametry:
Principles, instrumentation, linear sweep voltammetry, hydrodynamic and cyclic voltammetry, Stripping voltammetry, applications.

3) Coulometry:
Theory, principles, Instrumentation, various coulometers, coulometric titrations, advantages, limitations and applications.

4) Amperometry:
Principles, instrumentation, amperometric titrations, applications.

5) Radioanalytical methods of analysis :
a) Neutron activation analysis, principle, technique, steps involved in neutron activation analysis. Radiochemical and instrumental methods of analysis, important applications of NAA.
b) Isotope dilution analysis-principle and types of isotope dilution analysis. Typical applications of isotope dilution analysis.
c) Radiometric titrations–principle and techniques based on complex formation and precipitation, Radiometric titration curves for estimation of ions from their mixture.

6) Thermal Methods of Analysis :
Effect of heat on Materials, Chemical decomposition and TG curves, Analysis of TG curve to show nature of decomposition reactions , the product and qualities of compounds expelled, applications, instrumentation , TG in controlled atmosphere DTA: instrumentation and Methodology, applications, DSC: theory, instrumentation and applications, Thermometric titrations and applications.

7) Spectroelectrochemistry:
Principle and applications of spectroelectrochemistry and chemically modified electrodes and electrochemical sensors.

REFERENCES :

1) Introduction to instrumental analysis - By R. D. Braun Mc Graw Hill (1987).

2) Instrumental methods of chemical analysis - By H.H. Willard, L.L. Merrit, Jr. J.A. Dean and F.A. Settle Jr. Sixth Edition CBS (1986).

3) Thermal analysis - By W.W. Wendlandt, John Willy, N.Y. (1986).

4) Fundamentals of analytical chemistry - By D.A. Skoog, D.M. West and H.J. Holler, Sixth Edition (1992).

5) Cyclic Voltametry and Frontiers of electrochemistry - By N. Noel and K.I. Vasu, IBH, New Delhi (1990).

6) Essentials of Nuclear Chemistry, H. J. Arnikar, Wilay Eastern Limited, Fourth edition (1995).

7) Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler and J.A. Nieman, Fifth Edition, Saunders College Publishers (1998).

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGAC- 302 : MODERN ASPECTS OF ANALYTICAL CHEMISTRY

Total Credits: 04 **Total Lectures: 60Hrs**
Course Content:

A) Electronics in Chemical Instrumentation.

1) Introduction to Components :

Resistors, capacitors, inductors, transformers, charging and discharging of condensers, LC and RC circuits, parallel circuits, Ohm's law. Kirchhoff's law, Faradays laws of electrolysis and its applications.

2) Semiconductors :

Classification of semiconductors on the basis of band theory, Intrinsic and Extrinsic semiconductors, p-n junctions, basic principles of operations, p-n diode and its applications, Zener diode and its use in voltage regulation. Light emitting diodes, photodiodes and photo resistors.

3) Amplifiers :

Classification of amplifiers depending on coupling, mode of operation and frequency response NPN and PNP transistors.

4) Digital electronics:

Binary number, Decimal number and their conversion Binary addition of 4 bit number, logic gates, AND, OR, NOT, NAND, NOR, block diagram of computer, modem PC specification, IC (integrated circuits), classification, characteristic of ICS.

B) Modern Techniques of Analysis of Selected Inorganic Materials :

5) Analysis of Minerals and Ores:

Principles underlying the separation and determination of constituents of minerals and ores like chalcopyrite, ilmenite, monazite, etc.

6) Analysis of steels:

Analysis of steels for the determination of elements like carbon, sulphur, silicon, phosphorus, boron, chromium, tungsten, molybdenum, vanadium, nickel, etc.

7) Analysis of copper based alloys :

Alloys such as brass, bronze, gun metal, etc.

8) Analysis of Fertilizers:

Estimation of macronutrients, nitrogen, phosphorus, potassium from fertilizer samples. Estimation of micronutrients like boron, manganese, zinc and molybdenum.

9) Analysis of cement :

Introduction, composition and ingredients in cement. Principles in the analysis of cement. Analysis of silica, calcium, iron etc. by different methods of analysis.

REFERENCES :

1) Introduction to chemical Analysis - By R.D. Braun, Mc Graw Hill 1987.

2) Instrumental Methods of Analysis - By H.H. Willard, L.L. Merritt Jr, J. A. Dean and F.A. Settle Jr. 6th Edition, CBS publishers and distributors (1986).

3) Principles of Instrumental Analysis - By D.A. Skoog, F.J.Holler and T.A.Nieman, 5th edition, Saundess College Publishers.

4) Voegel's Textbook of Quantitative Chemical analysis, Fifth edition - By G.H.Jeffery, J. Basset, J. Mendham and R.C. Denney, ELBS (1997).

5) Standard methods of chemicals analysis
F.J. Welcher - Sixth edition, Volume two - Part-B.
Robert E. Krieger publishing company, Malabar, Florida, (1975).

6) Standard methods of chemical analysis :
F.J. Welcher - Sixth edition, Volume three - Part-B.
Robert E. Krieger publishing company, Malabar, Florida (1975).

7) Digital electronics by Malvino.

8) Fundamentals of electronics – U. K. Mehata.

M. SC. II (ANALYTICAL CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGAC- 303 : RECENT ANALYTICAL TECHNIQUES

Total Credits: 04 **Total Lectures: 60Hrs**
Course Content:

1. Analytical Spectroscopy

I. Electromagnetic radiation, properties, interaction of radiation with matter, classification of analytical methods based on EMR spectrum.

II. Instrumentation: Sources of radiations, monochromators, sample containers, detectors for various types of radiations.

III. Types of Analysis of EMR : Absorption, Beer's law, Deviations from Beer's law; instrumental causes for deviations from Beer's law; instrumental noise, chemical causes for deviations from Beer's law.

IV. Laser Based Technique: Atomic fluorescence spectroscopy, resonance ionization spectroscopy, laser enhanced ionization, principle, types of transition tunable laser, classification of medium pumping and controlling mechanism, instrumentation, detecting of various gases, liquid and solids, sources, cell, monochromators, detector.

2. Atomic Absorption Spectroscopy

Theory, sources, burners, atomic emission spectra, atomic absorption spectra, effect of temperature on emission, absorption and fluorescence, electrothermal atomizers, radiation sources for atomic absorption methods, Instrumentation for AAS, spectral interferences, applications in Industry.

3. Mass Spectroscopy

Inductively coupled plasma and direct current plasma emission spectroscopy. Atomic and molecular mass spectrometry including ICP-MS and tandem mass spectroscopy, MS-MS principle, instrumentation, applications.

4. Methods of Clinical Analysis :

1) Body fluids :

Composition and detection of abnormal levels of certain constituents leading to diagnosis of diseases. Analysis of Physiological fluids - urine, blood and serum, physiological and nutritional significance of water soluble and fat-soluble vitamins, minerals, analytical techniques for vitamins including microbiological techniques.

2) Human - nutrition :

Estimation of enzymes, carbohydrates, essential amino acids, proteins and lipids.

5. Automated Analysis :

Automated laboratory analysis, computerization, automated laboratory apparatus - continuous flow analyzers, flow injection analyzers, discrete sample analysis, centrifugal force analyzers, automatic titrators, robots, process control - process-control analyzers.

6. Analysis of detergents :

General scheme of analysis, sampling, Alcohol soluble materials, Test for sulphonated and unsulphonated material.

REFERENCES :

1) Encyclopedia of analytical chemistry.

2) Introduction to instrumental analysis - By R.D. Braun Mc Graw Hill (1987).

3) Instrumental methods of chemical analysis - By H.H. Willard, L.L. Merrit, Jr. J.A. Dean and F.A. settle, Jr. Sixth Edition CBS, (1986).

4) Analytical chemistry of foods - By Ceiwyn S. James.
Blackie academic and professional - Chapman and Hall publisher, Madras, 1st Edn. (1995).

5) Introduction to food science and technology - food science and technology series - By G.F. Stewart and M.A. Amerine, Academic Press.

6) Chemical analysis of food - By Pearson.

7) Practical Biochemistry in clinical Medicine - By R.L.Nath, Academic Publishers, Calcutta 2nd Edn. (1990).

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER III
(CBCS-2018 COURSE)
PGAC- 304 : ANALYSIS OF PHARMACEUTICALS

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1) Introduction :

Drug laws and schedules:
Drug and Cosmetics Act: Govt. Analyst, Drug Inspector, Requirement for approval of quality control laboratories, Administrative, Analytical and Executive bodies for analytical purpose, Introduction of new drugs.

2) Good Laboratory Practices:
LD_{50}, ED_{50}, Teratogenicity, Mutagenicity, Clinical Trials, etc.

3) Relative Quality System:
ISO, WHO etc. and their application in Pharmaceutical industry, Regulatory requirements related to current good, manufacturing practices in Pharmaceutical industry [Q. C. areas], Quality assurance, Quality control [Documents and Formats], Validation and Analytical methods.

4) Impurities:
Introduction to Pharmacopoeias and Monographs; Sources and types of impurities, Tests for purity, Limits of impurities, Factors considered for fixing limits and limit tests, Limit tests for chloride, sulphate, heavy metals, arsenic, iron and lead.

5) Quantitative Assay :

Principles of assays of following drugs:
Aspirin, Trimethoprim, Aminophylline, Calcium gluconate, Hydrogen peroxide, Ascorbic acid, Ferrous sulphate, Ciprofloxacin, Insulin.

6) Quality Control of Dosage Forms :

Introduction to dosage forms and their classification, Quality control, standards for various dosage forms i.e. Tablet, Capsule, Parentrals, Injections, Powders, Ointments, Creams, Solutions, Suspensions, Emulsions.
Test for sterility, Microbial assay of antibiotics and vitamins, Microbial limit tests, Quality control of Glass, Plastic, Rubber containers and closures.
Inprocess quality control, statistical quality control.

7) Stability studies
Introduction, Pathways of degradation, Calculation of shelf life.

REFERENCES :

1) Pharmacopoeia of India, Vol. I and Vol. II ; Published - By Government of India, Ministry of Health and Family Welfare, [Latest edition.]

2) United States Pharmacopoeia, Published - By British Pharmacopoeia Commission.

3) British Pharmacopoeia, Vol. I and II, Published - By British Pharmacopoeia Commission.

4) Pharmaceutical Analysis, Vol. I and II - By A. V. Ksture, S. G. Wododkar, K.R. Mahadik and H. More.

5) Practical Pharmaceutical Chemistry, Vol. I and II - By A. H. Beckett and J. B. Stalake, [C. B. S. Publishers, Delhi.]

6) Modern Dispensing Pharmacy - By Dr. A. P. Pawar and R. S. Gaud, [Carrer Publications, Second Edition.]

7) Pharmaceutical Microbiology and Biotechnology - By Dr. C. R. Kokare, [Nirali Publication, Third Edition.]

8) Pharmaceutical facilities, [Design, layout and validation] by Dr. Manohar A. Potdar .

9) Pharmaceutical Quality Assurance by Dr. Manohar A. Potdar . [Nirali Prakashan]

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGAC- 401: ADVANCED ANALYTICAL TECHNIQUES

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1) Infra Red Spectroscopy:

i) MID IR, Absorption spectroscopy, sample handling, Qualitative and Quantitative analysis

ii) MID IR, Reflection spectroscopy, types of reflection, Instrumentation, ATR

iii) Near IR Spectroscopy, Instrumentation, applications of near IR absorbance and reflectance spectrometry

iv) Far IR spectroscopy and IR emission spectroscopy

2) Raman Spectroscopy : Theory, Mechanism, Instrumentation, Applications of Raman spectroscopy to biological materials, Inorganic and organic species.

3) Nephelometry and Turbidimetry

Introduction, Turbidimetry and Colorimertry, Nephelometry and Fluorimetry, Choice Between Nephelometry and Turbidimetry Theory, Comparision of Spectrophotometry,Turbidimetry and Nephelometry, Instrumentation, Applications of Turbidimetry and Nephelometry

4) Fluorimetry and Phosphorimetry

Introducton, Comparision of Absorption and Fluorescence Methods
Theory, Instrumentation, Application of Fluorimetry, Application of Phosphorimetry, Comparision Fluorimetry and Phosphorimetry, Comparison Fluorimetry and Phosphorimetry with Absorption Methods

5) Nuclear magnetic resonance spectroscopy - Introduction, theory, chemical shifts, spin splitting, solvents, qualitative and quantitative analysis, non-protonic NMR spectra, multiple resonance, nuclear overhauser effect.
NMR spectra of solids, kinetic studies, Limitations of NMR spectroscopy, 2-D NMR magnetic resonance imaging.

6) Electron paramagnetic spectroscopy - Introduction, theory, instrumentation, applications to qualitative and quantitative analysis.

7) X-ray methods of analysis :

Principle of x-ray analysis, instrumentation, x-ray absorption apparatus, applications of x-ray absorption methods, Non-dispersive x-ray absorption method, x-ray diffraction methods, applications of x-ray methods.

8) Electron spectroscopy - Principle of ESCA, ESCA satellite peaks, chemical shifts, Instrumentation and typical analytical applications, Augar electron spectroscopy.

9) Electron microscopy - Introduction, Principle, instrumentation and applications, Electron stimulated microanalysis methods, SEM and TEM applications to nano materials, the atomic force microscopy, typical applications

REFERENCES :

1. Introduction to instrumental analysis - By R.D. Braun, McGraw Hill - International Edn.

2. Principles of Instrumental Analysis - By D.A. Skoog, F.J. Holler and T.A. Nieman, 5th edition, Saundess College Publishers (1998).

3. Fundamentals of Analytical chemistry - By D.A. Skoog, D.M. West and F.J. Holler, 6th edition, Saunder College Publisher (1992).

4. Instrumental Methods of Analysis - By H.H.Willard, L.L. Merritt Jr, J.A. Dean and F.A. Settle Jr. 6th edition, CBS publishers and Distributors (1986).

5. Analytical Chemistry - By G.D. Christian, 5th Edition, Gopsons Papers Ltd., Noida.

6. Analytical chemistry principles - By John H. Kenedey.
- Second edition, Saunders College Publishing.

7. Electron microscopy in the study of material - By P.J., Grundt and G. A. Jones, Edward Aznold.

8. Standard methods of chemical analysis - By F.J. Welcher, Vol. 3.
Part-A sixth edition (1966) D.van Nostrand Company, Inc.

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGAC- 402: RECENT SEPARATION TECHNIQUES

Total Credits: 04 **Total Lectures: 60Hrs**

Course Content:

1) Solvent Extraction:

Introduction, Principle of the technique, Distribution coefficient (D), Distribution ration (KD), Relation between KD & D. Different recent theories of solvent extraction, Sequence in the extraction process, Analytical separation techniques, Bath extraction, Continuous extraction, counter – Current extraction, Solid phase extraction, Solvent extraction by flow, Infection analysis, Solvent extraction systems, Chelate systems, Influence of solvents, Ion association systems, Special extraction systems.

2) Introduction to chromatography :

Theory, chromatographic band broadening, efficiency, resolution.

3) Liquid chromatography :

a) Liquid - solid chromatography, LSC stationary phases, LSC mobile phases, LSC detectors, functional groups adsorbed on LSC columns.

b) Liquid-Liquid chromatography, Ion-exchange chromatography - Ion exchange resins, Ion - exchange apparatus, Ion-chromatography.

4) High performance liquid chromatography :

Stationary phases, mobile phases, instrumentation, applications in pharmaceutical, chemical and biological fields.
Size-exclusion chromatography and Gel chromatography.

5) Gas- chromatography :

Retention time and retention volume, apparatus, carrier gases, injectors, columns– packed columns, open tabular columns, stationary phases, detectors, Temperature effects, qualitative and quantitative analysis, super critical fluid chromatography.

6) High-phenated techniques :

Applications of GC-MS, GC-IR, MS-MS, HPLC-MS. LC-MS

7) Ultracentrifugation in nano-materials :

Principle, sedimentation, methodology and applications, separation by distillation, crystallization, sublimation zone-refining, reverse osmosis, freezing.

REFERENCES :

1. Analytical chemistry - By G.D. Christian 5th Edn. 2001.

2. Introduction to instrumental analysis - By R. D. Braun, Mc Graw Hill international Edu.

3. Principles of Instrumental Analysis - By D.A. Skoog, F.J. Holler and T.A. Nieman, 5th Edn., Saunders College Publishers.

4. Fundamentals of Analytical chemistry - By D.A. Skoog, D.M. West and F.J. Holler 6th Edn. Saunders College Publishers.

5. Instrumental methods of analysis - By B. L. Krager, H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle ; C. B. S. - Publishers, Delhi (1986).

6. An introduction to separation sciences - By L. R. Shyder and C. H. Harvath, Wilfey - Interscience.

7. Basic concepts of analytical chemistry - By S. M. Khopkar, New Age International (P) Limited Publishers, (1999).

8. Quantitative analytical chemistry - By J. S. Eritz and G. H. Scliek, 5th Edn., Allyn and Racon (1987).

9. Environmental Chemical analysis - By M. S. Cress and Morr, American Publication (1988).

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGAC- 403: ENVIRONMENTAL ANALYSIS

Total Credits: 03 **Total Lectures: 45 Hrs**
Course Content:

1. Industrial Water pollution Control
a) Introduction – Industrial, Domestic, Drinking water quality
b) Undesirable Industrial Water characteristics.
c) Toxicity identification of effluent.
d) In-plant waste control.
e) Waste water treatment process and process selection.
f) Pre and primary treatment (Common treatment technologies).

2. Physico-chemical and chemical techniques used in industrial waste water treatment
a) Adsorption
b) Ion-exchange
c) Ultra filtration
d) Reverse osmosis
e) Co-agulation precipitation
f) Chemical oxidation with O_3, H_2O_2, Cl_2 etc.

3. Electroplating Industry
a) Raw material by-product and their role in process selection.
b) Chromate removal and water reuse.
c) Restoration of heavy metal.

4. Dye Industry
a) Natural and Synthetic dyes.
b) Characterization of liquid effluents.
c) Physical, chemical and biological treatment.

5. Green chemistry for a sustainable future
a. Introduction
b. The key concept of atom economy
c. Hazard Reduction
d. Beed stocks
e. Reagents
f. Media
g. The role of catalysts
h. Biological alternatives
i. Applications of green chemistry

REFERENCES :

1. Environmental Chemistry, 5th edition, By A. K. De, New Age International Ltd.
2. Environmental Chemistry, By S. K. Banerji, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Environmental Pollution Analysis, By S. M. Khopkar, Wiley Eastern Ltd.
4. Environmental Chemistry, By S. E. Manthan, 6th edition.
5. Standard methods of Water and Waste water Analysis, By A. K. De.
6. Water Analysis, By J. Rodier.
7. Industrial Water Pollution Control, 3rd Edition, W. Wesley Eckenfelder, Jr. McGRAW HILL Internationl Edition.
8. Environmental Biotechnology, Indu Shekhar Thakur, IK Internationl.

M. SC. II (ANALYTICAL CHEMISTRY)
SEMESTER IV
(CBCS-2018 COURSE)
PGAC- 404 : COMPUTER INTERFACE WITH CHEMISTRY

Total Credits: 03 **Total Lectures: 45 Hrs**
Course Content:

1. Curve fitting (Functional approximation)

2. Interpolation and Intrapolatin

3. Solving algebraic equations [f(x) = 0]
Bisection, Newton-Raphlson, Secant method

4. Numerical integration
Trapeloidal, Simpson one third method, Simpson three by eight method

5. Unconstraint optimization

6. Monte-Carlo method
i) For calculating integral
ii) For computing area

7. Molecular modeling with examples

8. Structure of crystals with examples

9. Learning to use Chem 3D (Chem Draw)

REFERENCES :

Numerical Algorithms - By Krishnamurthy and Sen
Manual for Chem 3D

M. SC. II ANALYTICAL CHEMISTRY
SEMESTER IV
(CBCS-2018 COURSE)
PGAC -405 : MODERN METHODS OF ANALYSIS

Total Credits: 03 **Total Lectures: 45 Hrs**
Course Content:

1) Analysis of Cosmetics :

a) Determination of water, Ethanol, Tropanol Glycol in cosmetics, Analysis of deoderants and anti-perspirants, aluminum, zinc, zircomium, boric acid, chloride, sulphate, Hexachlorophyll, Methanovin, Phenol sulphonate urea.

b) Analysis of face - powder: Fats, fatty-acids, Boric acid, calcuium, magnesium, barium, titanium and iron. Oxides of titanium, iron and aluminium (Total).

c) Analysis of Hair - tonic preparation : 2, 5-diammino tolune, $KBrO_3$, Sodium per borate, pyrogallol, resorcinol, salicylic acid and dithioglycodic acid.

d) Analysis of vanishing creams : Types of Emulsions, chloroform soluble material, glycerol, homo-genizers, stabilizer and antioxidants.

2) Analysis of Forensic Samples :

a) Toxicology : Isolation, identification and determination of following :

i) Narcotics : Heroin and cocaine
ii) Stimulants : Caffeine, amphetamines
iii) Depressants ; Barbiturats, benzodiazepines
iv) Hallucinodens : LSD
v) Metabolloids : Drugs in blood and urine of addicts.

b) Forensic science acts :

i) Drugs and cosmetic acts
ii) Medicinal and toilet preparation (Excise duties) act.
iii) Narcotics and psychotropics - substances act.

3) Analysis and testing of polymers :

a) Chemical analysis of polymers : X-ray diffraction, thermal analysis, TGA, DTA.

b) Physical testing of polymers : Mechanical properties, fatigue testing, impact testing, Tear - Resistance, Hardness, Brassion resistance.

c) Thermal properties : Softening temperature, flammability.

d) Optical properties : Colour transmittance and transparency.

e) Electrical properties : Dielectric constant and Loss factor, resistivity, dielectric strength, electronic properties.

f) Chemical properties : Resistance to solvents, vapour permeability, weathering.

REFERENCES :

1. Standard methods of chemical analysis, volume 3, Part-B - By F.J. Welcher.

2. Cosmetics - By W.D. Poucher three volumes.

3. Industrial water pollution control 3rd Edition - By W.W. Ecken and elder, Jr. Mc Graw-Hill (2000).

4. Analytical methods of Forensic Chemistry, Ed. Homath, Ellis Horwood (1990).

5. Text book of Forensic Pharmacy - By B. M. Mithal, 9th edn. (1993), National Centre, Calcutta.

6. V. Malik, Drug and Cosmetic Act.

7. Drug and Cosmetics Act - V. Malik.

8. Textbook of Polymer Science IIIrd Edition - By Fred. W. Billmeyer Junior IIIrd Edition John Willey and Sons. (1994).

9. Principles of Polymer Systems - By F. Rodrigue Tata Mc Graw Hill New-Delhi.

10. Principles of Polymer Chemistry - By P.J. Flory Cornel uni press New-York.

11. Polymer Chemistry - An Introduction Seymour-Carraher-Marcel Dekker, Inc.New - York.

12. Polymer Science - By Vasant Gowarikar Wiley Eastern New - York, (1988).

13. Polymer Science - By V.R. Gowarikar, N.B. Vishvanathane, New Age International Ltd. Publishers, Relevant Pages, 1998.

21. Textbook of Polymer Science - By Fred. W. Billmeyer Junior IIIrd Edition, Relevant Pages. 1994.

M. SC. II (ANALYTICAL CHEMISTRY)
SEMESTER III & IV
(CBCS-2018 COURSE)
PGAC- 407: PRACTICAL COURSE-I

Total Credits: 02
Course Content:

(Any Twelve Experiments)

1) To determine the half-wave potential of a metal ion polarographically.

2) Polarographic analysis of zinc with DME.

3) Polarographic determination of cadmium in solution.

4) Nephelometric analysis of barium as sulphate.

5) Determination of iron in natural water colorimetrically.

6) Determination of uranium colorimetrically by 8-hydroxyquinoline method.

7) Simultaneous spectrophotometric determination of chromium (VI) and manganese (VI).

8) Determination of fluoride spectrophotometrically by the alizarin red method.

9) Determination of normality of weak acid conductometrically by Righellato and Davies method.

10) Determination of oxidation state of metal ion by the method of concentration cell without transference potentiometrically.

12) Flame photometric determination of Li/ Na/ K.
- i) Calibration curve,
- ii) Standard-Addition
- iii) International standard method

13) Amperometric titration of lead with dichromate.

14) Determination of sulphate turbidometrically.

15) Determination of moisture content in a given sample using Karl-Eisher titration.

16) High frequency titration of calcium in presence of srontium and barium.

17) Recording of TGA curves of calcium and magnesium oxalates separately and determination of percentage composition from given mixture.

18) Statistical treatment of experimental data, evaluation of percentage error in the given experimental data by the method of least squares.

REFERENCES :

1. Applied Chemistry - Theory and Practice, O. P. Veramani, A. K. Narulla, By Wiley Eastern Limited (1989).

2. Quantitative Inorganic Analysis, By A. I. Vogel, 3rd edition, E.L.B.S. (1961).

3. Fundamentals of Analytical Chemistry, By D. A. Skoog, D. M. West F. J. Holler, 6th edition, Saunders College Publishers (1992).

4. Vogel's Textbook of Chemical Analysis, Revised By G. H. Jefferry, J. Bassett, J. M. Mendham, R. C. Denney, 5th edition, E.I.B.S.. (1991).

5. Instrumental Methods of Analysis, By H. H. Willard, L.L. Merritt, J.A. Dean, F. A. Settle, 6th edition, CBS Publishers and Distributors (1986).

6. Practical Chemistry (M.Sc. Part-I), By S. S. Dodwad, D. K. Vardhan and others, Chetana Book Dept., Bombay-4.

7. Colorimetric determination of traces of metals, By E. B. Sandell, Inter-Science Publications (1958).

8. Experiments in Chemistry, By Dr. D. V. Jahagirdar Himalaya Publishing House (1994).

9. Systematic Experimental Physical Chemistry,
By S. W. Rajbhoj and Dr. T. K. Chondhekar,
Anjali Publications, Aurangabad (1990).

10. Standard Methods of Chemical Analysis,
By E. J. Welcher (editor), Krieger (Reprint 1975).

M. Sc. II (ANALYTICAL CHEMISTRY)
SEMESTER III & IV
(CBCS-2018 COURSE)
PGAC- 408 : PRACTICAL COURSE-II

Total Credits: 02
Course Conten:

(Any Twelve Experiments)

1) Analysis of Stainless steel alloy with respect to chromium and iron.

2) Analysis of Brass alloy with respect to copper and zinc.

3) Analysis of Haematite are with respect to insoluble matter (SiO_2) and iron.

4) Analysis of Ilmenite ore with respect to insoluble matter (SiO_2), iron and titanium.

5) Analysis of Pyrolusite ore with respect to insoluble matter (SiO_2), manganese and iron.

6) Separation of N_i^{+2} and Zn^{+2} cations by using Anion exchanger resin and estimation by complexometric method.

7) Separation of Cl^- & Br^- anions by using Anion exchanger resin and estimation by precipitation method.

8) Separation of binary mixture of cation by using paper chromatography (Two mixtures).

9) Analysis of calcium lactate by complexometric method.

10) Estimation of available chlorine from given sample of Bleaching powder.

11) Estimation of COD from the given sample of waste water.

12) Estimation of NPK from mixed fertilizer sample.

13) Analysis of iodized table salt.

14) Analysis of soda ash.

15) Estimation of Hg from given Hg - salt sample complexometrically.

16) Estimation of Ca from given chalk sample.

17) To perform the Assay of

a) H_2O_2
b) $FeSO_4, 7H_2O$
c) $CuSO_4, 5H_2O$

REFERENCES :

1. A text-book of Quantitative Inorganic Analysis.
By A. 1. Vogel, Third edition,
The English Language Book Society (1960)

2. Fundamentals of Analytical Chemistry -
By D.A. Skoog, D.M. West, S.J. Holler,
6th Edition, Saunders College Publishing, (1991)

3. Vogel's text-book of Quantitative Inorganic Analysis,
Fifth edition, ELBS (1991)

4. Standard methods of chemical Analysis. A set of volumes edited - By F. J. Welcher, Robert L. Krieger Publishing Company.

5. Pharmacopia of India, Vol. I and Vol. II Published - By Government of India, Ministry of Health and Family Welfare, Latest Edition.

6. Practical Pharmaceutical Chemistry. Vol. I and Vol. II - By Kasture, S. G. Wododkar, K. R. Mahadik and H. N. More.

7. Practical Pharmaceutical Chemistry, Vol. I and Vol. II - By A. H. Beckett and J. B. Stanlake, C.B.S. Publishers, Delhi.

M. Sc. II ANALYTICAL CHEMISTRY
SEMESTER III & IV
(CBCS-2018 COURSE)
PGAC- 409: PRACTICAL COURSE-III

Total Credits: 02
Course Content:

(Any Twelve Experiments)

1) Determination of Ascorbic acid (Vit. 'C') from given Vit. Tablets.

2) Determination of cholesterol colourimetrically.

3) Isolation of Caffine from tea leaves.

4) Determination of Iodine value from given vegetable oils.

5) Determination of sulphadiazine/ sulphonamide.

6) Determination of saponification value of a given oil sample.

7) Determination of aspirin, paracetamol and caffine from APC tablet.

8) Determination of acid value of given fatty acids.

9) Determination of the carbonyl content by hydrazone method.

10) Determination of equivalent wt. of organic acid by silver-salt method.

12) Isolation of casein and lactose from milk.

13) Determination of nitro group by reduction method.

14) Assay of food colours.

15) Assay of soaps and detergents.

16) Assay of polymers and plastics.

17) Analysis of vitamin A in food products.

18) Analysis of vitamin C in juices and squashes.

19) Identification of organic compounds by their IR spectra.

REFERENCES :

1. Organic Laboratory Techniques (Second Edition),
By Pavia and Others, Sannders series (Harcors and Brace).

2. Practical Clinical Biochemistry
By Harold Varley (4th edition)
CBS publishers and distributors, New Delhi.
3. Organic Laboratory Techniques, A microscale approach By Donald L. Pavia and others.
4. Indian Pharmacopoeoa (Vol. I and Vol. II), 1996.
5. Fundamental of Chemical Analysis; By D. A. Skoog, West and Holler (6th edition), Saunders College Publishers (1992).

M. Sc. II ANALYTICAL CHEMISTRY
SEMESTER III
(CBCS-2018 COURSE)
PGSEC 305: ASSESSMENT OF WATER QUALITY

Total Credits: 02 **Total Lectures: 30Hrs**

Course Content:

The main objective of course is to improve the awareness and skills of the students in modern techniques of analysis of water for research and extension activities. Use of instruments and their general upkeep/maintenance, interpretation of analytical data and formulation of reports/recommendations.

The course is designed to cover water characteristics, testing techniques and methods of interpretation of data, so as to make it more useful in the context of global competition in quality and precision of analysis.. About the Course: The course will cover some theory lectures on topics most relevant to the subject along with appropriate number of practical exercises with greater emphasis on analytical techniques adopting a demonstration and learning-by-doing type of approach. Interpretation of test results and formulation of recommendations and/or reports will be a vital component.

The course context: Collect samples in scientific way from residential plumbing and municipal distribution systems for analysis Take physical tests like (Colour, pH, Temp etc) at the spot and use preservatives for further analysis Conduct chemical tests of samples in lab (e.g. Alkalinity, Hardness, TDS. DO, COD etc with biological tests) as possible as. To conduct chlorine residual or turbidity tests.Compare the obtained values with WHO, CPCB or BSI Standards

References:

1. Hand Book of Methods in Env. Studies by S.K. MAITI ABD Publishers, Jaipur, India.
2. Instrumental methods of chem. Analysis G. R. Chatwal and Anand Himalaya publishing house, New Delhi.
3. Environmental Science Principle & Pract. R. C. Das & Behera Prentice Hall of India pvt. Ltd. New Delhi.