

**BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE (INDIA)**

SYLLABUS OF MASTER OF SCIENCE (CHEMISTRY)

**Learning Outcomes based Curriculum Framework
(LOCF)**

for

M.Sc.II (ANALYTICAL CHEMISTRY)

SEMESTER-III

[CBCS- 2018 Course]

TO BE IMPLEMENTED FROM JUNE 2018

M.Sc.II (ANALYTICAL CHEMISTRY)

SEMESTER-III

PGAC- 301 : THERMAL, RADIO AND ELECTROANALYTICAL METHODS

Total Credits: 04

Total Lectures: 60Hrs

Course Learning Outcomes:

At the end of course student will be able to –

- CO 1 : To study polarography and advancement in polarography.
- CO 2 : Study of voltammetry method of analysis
- CO 3 : Study of coulometry with its limitations and applications
- CO 4 : Study of amperometry and their applications
- CO 5 : To know about radioanalytical methods of analysis and their principles and applications.
- CO 6 : To know about thermal methods of analysis like TGA, DTA and DSC.
- CO 7 : To understand spectroelectrochemistry and their applications

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 N₂ flushing, Applications.

B) Advancements in polarography:

Electrodes, excitation signals, DC polarography pulse and differential pulse polarography, square wave polarography.

2) Voltammetry:

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.

Reference Books:

- 1) Introduction to instrumental analysis - By R. D. Braun McGraw 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).

PGAC- 302 : MODERN ASPECTS OF ANALYTICAL CHEMISTRY

Total Credits: 04

Total Lectures: 60Hrs

Course Learning Outcomes:

- CO 1 : To study about RC and LC circuits, Ohms Law, Krichhoffs Law, Faradays Laws of electrolysis and its applications.
- CO 2 : To learn about semiconductors and its aspects.
- CO 3 : To learn about amplifiers, NPN and PNP transistors.
- CO 4 : To understand digital electronics in brief
- CO 5 : To know about minerals and ores like ilmenite, monazite, chalcopyrite etc.
- CO 6 : To study about analysis of steels.
- CO 7 : To study the analysis of copper based alloys.
- CO 8 : To know about estimation of micronutrients, nitrogen, phosphorus, potassium etc, from fertilizer samples
- CO 9 : To understand analysis of cement and its aspects.

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.

Reference Books:

- 1) Introduction to chemical Analysis - By R.D. Braun, McGraw 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.

PGAC- 303 : RECENT ANALYTICAL TECHNIQUES

Total Credits-04 Total Lectures – 60Hrs

Course learning outcomes

- CO 1 : To study and understand about electromagnetic radiation, analysis of EMR, laser based techniques in analytical spectroscopy
- CO 2 : Study in brief Atomic absorption spectroscopy and their aspects
- CO 3 : Study in brief mass spectroscopy, MS- MS principle and its applications.
- CO 4 : To know about methods of clinical analysis in body fluids and human nutrition
- CO 5 : Learn and understand automated analysis.
- CO 6 : Study the analysis of degradation of alcohol suitable material, sulphonated and unsulphonated material.

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.

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.

Analysis of detergents :

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

Reference Books:

- 1) Encyclopedia of analytical chemistry.
- 2) Introduction to instrumental analysis - By R.D. Braun McGraw 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).

PGAC- 304 : ANALYSIS OF PHARMACEUTICALS

Credits-04 Total Lectures – 60Hrs

Course learning outcomes

- CO 1 : To study the Drug Laws, Govt. Act and its schedules
CO 2 : To know about LD50, ED50 and clinical trials.
CO 3 : To understand relative quality system, ISO, WHO and applications in pharmaceutical industries.
CO 4 : To know about impurities like pharmacopoeias, monographs etc.
CO 5 : To know principles of assays of few drugs.
CO 6 : To study about dosage forms, their classifications and standards for various dosage forms.
CO 7 : To study pathways of degradation and calculations of shelf life.

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:

LD₅₀, ED₅₀, 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.

Reference Books:

- 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 .[NiraliPrakashan]

PGSEC 305: ASSESSMENT OF WATER QUALITY

Credits: 02 Total Lectures: 30Hrs

Course learning outcomes

- CO 1 : To Improve the awareness and skills in modern techniques of analysis of water
- CO 2 : To study about physical tests such as Colour, pH, temp.
- CO 3 : Learn about hardness, TDS, DO, COD, BOD
- CO 4 : To know about WHO, CPCB and BSI Standard

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

Reference Books:

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.

