

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

SYLLABUS OF MASTER OF SCIENCE (CHEMISTRY)

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

for

M.Sc.II (ANALYTICAL/INORGANIC/ORGANIC CHEMISTRY)

SEMESTER-IV

[CBCS- 2018 Course]

TO BE IMPLEMENTED FROM JUNE 2018

M.Sc. (ANALYTICAL CHEMISTRY), SEMESTER-IV

PGAC- 401: ADVANCED ANALYTICAL TECHNIQUES

Total Credits: 04

Total Lectures: 60Hrs

Course learning outcomes

At the end of course student will be able to –

- CO 1 : Study of Infra Red spectroscopy and its aspects
- CO 2 : Learn and understand in brief about Raman Spectroscopy and its applications.
- CO 3 : Learn and Distinguish between Nephelometry, Turbidimetry, Colourimetry, Spectrophotometry.
- CO 4 : Understand aspects of Fluorimetry, Phosphorimetry and its applications
- CO 5 : Know about NMR and its chemical shifts, kinetic study and limitations of NMR
- CO 6 : Study of Electron paramagnetic spectroscopy and applications
- CO 7 : Learn X-ray method in brief
- CO 8 : Study of ESCA, ESCA satellite peaks and their applications
- CO 9 : Understand an introduction to Electron microscopy, SEM and TEM applications

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 Colorimetry, Nephelometry and Fluorimetry, Choice Between Nephelometry and Turbidimetry Theory, Comparison of Spectrophotometry, Turbidimetry and Nephelometry, Instrumentation, Applications of Turbidimetry and Nephelometry

- 4) **Fluorimetry and Phosphorimetry**
 Introduction, Comparison of Absorption and Fluorescence Methods, Theory, Instrumentation, Application of Fluorimetry, Application of Phosphorimetry, Comparison 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, Auger 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

Reference Books:

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, Saunders College Publishers (1998).
3. Fundamentals of Analytical chemistry - By D.A. Skoog, D.M. West and F.J. Holler, 6th edition, Saunders 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.vanNostrand Company, Inc.

PGAC- 402: RECENT SEPARATION TECHNIQUES

Total Credits: 04

Total Lectures: 60Hrs

Course learning outcomes

At the end of course student will be able to –

- CO 1 : Learn and Understand solvent extraction, relation between KD & D, extraction techniques
- CO 2 : To study the introduction and theory of Chromatography
- CO 3 : To understand Liquid Chromatography
- CO 4 : To understand High Performance liquid Chromatography
- CO 5 : To understand Gas- Chromatography
- CO 6 : Know the applications of High-Phenated techniques
- CO 7 : Learn about Ultracentrifugation in nano-materials and its aspects

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 tubular 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.

Reference Books:

1. Analytical chemistry - By G.D. Christian 5th Edn. 2001.
2. Introduction to instrumental analysis - By R. D. Braun, McGraw 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. SaundersCollege 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. Sclic, 5th Edn., Allyn and Racon (1987).
9. Environmental Chemical analysis - By M. S. Cress and Morr, American Publication (1988).

PGAC- 403: ENVIRONMENTAL ANALYSIS

Total Credits: 03

Total Lectures: 45 Hrs

Course learning outcomes

At the end of course student will be able to –

- CO 1 : Study of Industrial Water pollution Control
- CO 2 : Learn about chemical techniques used in industrial waste water treatment
- CO 3 : Know about Electroplating industry
- CO 4 : Understand Dye industry
- CO 5 : Understand about Green chemistry and its aspect with sustainable future

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 O₃, H₂O₂, Cl₂ 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

Reference Books:

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 International Edition.
8. Environmental Biotechnology, InduShekhar Thakur, IK International.

PGAC- 404 : COMPUTER INTERFACE WITH CHEMISTRY

Total Credits: 03

Total Lectures: 45 Hrs

Course learning outcomes

At the end of course student will be able to –

- CO 1 : To learn Curve fitting
- CO 2 : To study Interpolation and Intrapolatin
- CO 3 : To know about how to solve the Algebraic equations.
- CO 4 : To study the numerical integration
- CO 5 : To understand the Unconstraint optimization in chemistry.
- CO 6 : To know the Monto-Carlo method while tudyng the computer interface
- CO 7 : Study of Molecular Modelling
- CO 8 : Study of Structure of Crystals
- CO 9 : Learn to use Chem Draw

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)

Reference Books:

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

PGAC -405 : MODERN METHODS OF ANALYSIS

Total Credits: 03

Total Lectures: 45 Hrs

Course learning outcomes

At the end of course student will be able to –

- CO 1 : Understand the analysis of Cosmetics
CO 2 : To learn about Analysis of forensic samples and forensic science act
CO 3 : Study of Analysis and testing of polymers

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, calcium, magnesium, barium, titanium and iron. Oxides of titanium, iron and aluminium (Total).
- c) Analysis of Hair - tonic preparation : 2, 5-diammino tolune, KBrO₃, 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) Metaboloids : 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.

Reference Books:

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. McGraw-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 McGraw 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 VasantGowarikar Wiley Eastern New - York, (1988).
13. Polymer Science - By V.R. Gowarikar, N.B. Vishvanathane, New Age International Ltd. Publishers, Relevant Pages, 1998.
14. Textbook of Polymer Science - By Fred. W. Billmeyer Junior IIIrd Edition,

Relevant Pages. 1994.