

UNIVERSITY OF MADRAS

DEPARTMENT OF ANALYTICAL CHEMISTRY

M.Phil. Degree Course in Analytical Chemistry

Syllabus – Core Courses

CHE 121 : Research Methodology (5 credits)

Unit – I

Research Problem - Aim, objectives, criteria for selecting a research problem. Definition of research problem. Research in fundamental and applied sciences. Research in industries. Problems and hypothesis in research, development and testing of hypothesis.

Survey of literature - Chemical nomenclature and literature, primary and secondary sources of literature including reviews, treatises and monographs. Literature searching – general references sources, infotrac, Data base, internet, world wide web, chemical and analytical abstracts, science citation index, rating of journal. Responsibilities and functions of editors, referees. Scientific journals in India and abroad. Patents.

Writing of thesis/paper – General formats, tables, figures, references, foot notes, appendices, reviewing and revising the papers, proof reading and final format. Presentation of scientific papers in seminars and symposia. (20 hours)

Unit - II

Laboratory organisation: Designing the laboratory, installation of equipments, stores and management, preparation of storage of reagents. Safety in laboratory and workshop. Organisation of demonstration and exhibition.

Management of Laboratory – Upgrading the conventional laboratory to microscale chemical laboratory, laminar and non laminar flow laboratory, special instrumentation and facilities for microscale laboratory.

Automation in the Laboratory – Principles, automatic and semiautomatic instruments, autoanalyser, centrifugal analyser, flow injection analysis, smart instruments (20 hours)

Unit - III

Statistics for analytical chemistry: Significant figures in arithmetic – addition, subtraction, multiplication, division, logarithms and antilogarithms, significant figures and graphs.

Errors – random and systematic, precision and accuracy, uncertainty and propagation of uncertainty, Gaussian distribution, Student's t, Q and F tests, simple and multiple linear regression. (20 hours)

Unit – IV

Sampling: Theory of sampling, techniques, pitfalls, sampling in static and dynamic systems, sampling from polluted water and from eluates, sampling of air pollutants, aerosols, flyash. Transmission and storage of samples, techniques for handling air and moisture sensitive samples.

Microanalysis: Principles and applications of zone refining, fractional distillation, molecular distillation, deep-freeze crystallisation and contamination control in analytical operations. (20 hours)

REFERENCES

1. Quantitative Chemical Analysis, D.C. Harris, W.H. Freeman, New York, Fourth Edn. 1995.
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, Saunders College Publishing. New York, Sixth Edn. 1992.
3. Analytical Chemistry: Principles. J.H. Kennedy, Saunders College Publishing, New York, Second Edn. 1990.
4. Abstracting Scientific and Technical Literature, R.E. Maizell, J.F. Smith, T.E.R. Singer, Wiley – Interscience, New York, 1971.
5. Techniques of Technical Report Writing, T.K.S. Iyengar, M.R. Rao and S.L.V. Chari, Allied Publishers, Madras, 1978.
6. Research Paper Smart, L. Buffa, Random House, New York, 1997.
7. Statistics for Analytical Chemistry, J.C. Miller and J.N. Miller, Ellis Harwood, Chichester, 1984.
8. Statistics for Analytical Chemists, R. Caulcutt and R. Boddy, Chapman and Hall, London, 1982.
9. Microscale Manipulation in Chemistry, T.S. Ma and V. Herak, Wiley, 1976.
10. Laboratory Organisation and Administration, K. Guy, Macmillan, London, 1963.
11. Treatise on Analytical Chemistry, I.M. Kolthoff and P.H. Elving, (Eds.) Part I & III.

CHE 122 – Analytical Techniques and Instrumentation – I (5 credits)

Unit – I

Electronics: Operational amplifier – properties and characteristics of opamps, circuits employing opamps, amplification and measurements of signals, application of opamps to voltage and current control and for mathematical operations.

Digital Electronics: analog and digital signals, binary numbers, basic digital circuit components, microprocessors and microcomputers, components of computers, computer programs and applications, computer networks.

Electroanalytical Methods:

Potentiometry – Potentiometric titrations and ion selective electrodes.

Coulometry – Potentiostatic coulometry, coulometric titrations and mediators. (20 hours)

Unit – II

Voltammetry – Polarography – DME, polarograms, currents in polarography, maxima, effect of dissolved oxygen and application to chemical analysis, amperometric titrations.

Pulse polarography – Normal and differential pulse, square wave polarography, stripping analysis – cathodic and anodic stripping, potentiometric stripping, Linear sweep voltammetry, cyclic voltammetry, Types of electrodes and Chemically modified electrodes.

(20 hours)

Unit - III

Advanced Spectral Techniques: *Principle and brief outline of instrumentation and analytical applications of the following techniques.*

Application of laser sources in analytical chemistry.

Photoacoustic spectroscopy, Photoacoustic infrared spectroscopy.

Chemiluminescence.

Near and far IR.

Infrared emission spectroscopy.

Unit - IV

Fiber optics spectroscopy.

Two dimensional NMR.

Ion scattering spectroscopy.

Secondary ion mass spectrometry.

Hyphenated techniques – GC-MS, LC-MS, GC/LC-IR, LC-NMR, GC-OES. (20 hours)

CHE 123 – Analytical Techniques and Instrumentation-II (5 credits)

Chromatography: Principle, instrumentation, nature of stationary and mobile phases and method of detection and applications of the following techniques.

Unit – I

Gas Chromatography.

High Performance Liquid Chromatography.

High Performance Thin Layer Chromatography.

Ion Chromatography.

(20 hours)

Unit – II

Ion Exchange Chromatography.

Size Exclusion Chromatography.

Super Critical Fluid Chromatography.

Capillary Electrophoresis.

(20 hours)

Unit – III

Principle and application of

Kinetic method of analysis – kinetics, catalysis and enzyme catalysis

Clinical analysis – immunoassay and trace element analysis

Environmental analysis – Air (hydrogen sulphide, sulphur dioxide and oxides of nitrogen) and water (BOD, COD and trace elements like Cd, Cr, Pb, Se) analysis.

(20 hours)

Unit - IV

Nuclear chemistry and radiochemistry – Nuclear stability and structure, radioactivity and nuclear decay, detection and measurement of radiation, nuclear reactions, nuclear power reactors, application of radioisotopes, neutron activation analysis, isotopic dilution analysis, health and safety aspects.

(20 hours)

REFERENCES (For Papers CHE 103 and CHE 105)

1. Quantitative Chemical Analysis, D.C. Harris, W.H. Freeman, New York, Fourth Edn. 1995.
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, Saunders College Publishing. New York, Sixth Edn. 1992.
3. Principles of Instrumental Analysis, D.A. Skoog and J.J. Leary, Saunders College Publishing, New York, Fourth Edn. 1992.
4. Analytical Chemistry, G.D. Christian, Wiley, New York, Fourth Edn. 1986

5. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler and T.A. Nieman, Saunders College Publishing, New York, Fifth Edn. 1998.
6. Analytical Chemistry: Principles. J.H. Kennedy, Saunders College Publishing, New York, Second Edn. 1990.
7. Principles of Radiochemistry, D.D. Sood, N. Ramamoothy and A.V.R. Reddy, Eds. IANCAS, Bombay, 1993.
8. Substoichiometry in Radiochemical Analysis, J. Ruzicka and J. Stray, Pergamon Press, London, 1968.
9. Microscale Manipulation in Chemistry, T.S. Ma and V. Herak, Wiley, 1976.
10. Laboratory Organisation and Administration, K. Guy, Macmillan, London, 1963.
11. Treatise on Analytical Chemistry, I.M. Kolthoff and P.H. Elving, (Eds.) Part I & III.
12. Modern Polarographic Methods in Analytical Chemistry, A.M. Bond, Marcel Decker, New York, 1980.
13. Radioactivity Applied to Chemistry, Arthur C. Wahl, Wiley, New York, 1951.
14. Radiotracer Techniques and Applications, A. Evans and M. Muiamatsu, Marcel Decker, New York, 1977, Vol I & II.
15. Electrochemical Methods, A. Bard and L.R. Faulkner, Wiley, New York, 1980.
16. Advances in Electroanalytical Methods – Series. Ed. A. Bard.
17. Physical and Chemical Methods of Separation, B.W. Berg, McGraw-Hill, 1963.
18. Chemical Methods of Separation, J.A. Dean, Von Nostrand, 1969.
19. Environmental Chemistry, J.O.M. Bockris, Plenum Press, New York, 1977.
20. Separation and Purification Methods, E.S. Perry, Marcel Dekker, New York, 1975.

MASTER OF PHILOSOPHY PROGRAMME

M.Phil. Analytical Chemistry

Course Code	Title of the Course	Core/ Elective	Credits			
			L	T	P	C

First Semester

CHE121	Research Methodology	C	4	1	0	5
CHE122	Analytical Techniques and Instrumentation I	C	4	1	0	5
CHE123	Analytical Techniques and Instrumentation II	C	4	1	0	5

Second Semester

CHE124	Dissertation and viva-voce	C	-	-	-	21
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