

**POSTGRADUATE INSTITUTE OF SCIENCE
UNIVERSITY OF PERADENIYA**



**M.Sc. in Analytical Chemistry
2010/2011**

1. INTRODUCTION

The practice of analytical chemistry has now become an integral and essential component in many diverse spheres such as Food & Beverage industry, Pharmaceutical industry, Health care & medical technology, Environmental control, Electrochemical technology, Agriculture, etc. Many of the underlying principles of Analytical Chemistry can be seen routinely in analysis in many areas such as quality control, research and development work, manufacturing processes, and in industry, university, and other research laboratories.

A large majority of undergraduates leaving the universities at the end of their period of study find employment which entail application of Analytical Chemistry in their respective assignments. In many instances, for the efficient discharge of their duties, it is necessary that such graduates possess the ability to understand clearly the nature of a given problem, use a variety of analytical methodologies and techniques – both classical and instrumental – to obtain accurate and precise measurements of the system, operate and maintain analytical instruments, calculate the final result together with the associated error, and interpret the results to arrive at appropriate conclusions. Although undergraduate curricula provide a strong background in chemistry with a basic training in analytical aspects, a sound hands-on experience together with advanced principles of analytical chemistry is often beyond the scope of such curricula, mainly due to time constraints. The dearth of properly trained analytical chemists in Sri Lanka is a major drawback in the realization of our industrial and scientific potential, especially in the current atmosphere of increasing industrialization. The Board of Study in Chemical Sciences has now updated the M.Sc. programme in Analytical Chemistry introducing many new courses. This M.Sc. programme will thus prepare the candidate to take the challenge of meeting not only national needs in diverse areas as stated above, but also to continue toward a higher degree anywhere in the world.

2. OBJECTIVES OF THE PROGRAMME

To provide

- a sound theoretical foundation on important techniques of classical and instrumental analysis.
- the training in using, troubleshooting and maintenance of analytical instruments.
- strong knowledge on measurements and errors in chemical analysis, and calculation. and interpretation of results, leading to appropriate conclusions.
- adequate knowledge on the principles of analytical methods.

3. PROGRAMME ELIGIBILITY AND ADMISSION CRITERIA

Applicants seeking admission to this programme must have one of the following degrees/qualifications from a recognized university.

- (i) B.Sc. (Special) Degree in Chemistry or a B.Sc. Special/General Degree with Chemistry as a subject.
- (ii) Any other qualification accepted to be equivalent to any of the above by the Postgraduate Institute of Science, University of Peradeniya.

Candidates who meet eligibility requirements shall be required to sit a selection examination where their knowledge of Chemistry, Basic aspects of chemical analysis, Mathematics and English will be examined. Successful candidates will be called for an interview at which the final selection for admission shall be made. The final decision on eligibility for admission to the Diploma and M.Sc. degree programmes will be determined by the Board of Study in Chemical Sciences of the PGIS.

4. PROGRAMME FEE

	M.Sc. programme fee
Local candidates	Rs. 100000/-
SAARC countries	US \$ 3300/-
Other countries	US \$ 6600/-

Programme fees shall be paid in two instalments (*Rs. 50000/- at the registration and next Rs. 50000/- within six months from registration*). Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS.

5. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted over a period of two semesters of 15 weeks each. Eight (8) hours of lectures and 6 - 8 hours of practicals per week will be conducted during the weekends. The entire programme duration will be about 15-18 months inclusive of 3 - 6 months for the research project. Satisfactory completion of a minimum of 24 credits of course work (with a GPA of not less than 3.00) is required for the programme in addition to the 6 credits allocated for the full-time research project (*The student who does not satisfy the above criteria but obtains a GPA in the range 2.75 to 2.99 for course work is eligible for the Diploma in Analytical Chemistry but not the M.Sc. Degree*). **Continuous attendance on full-time basis is compulsory during the period of research work.** Within the first month of the research project, a literature seminar, independent of the research project should be conducted. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree. Based on the students' performance in the course work component, PGIS may upgrade their registration to M.Phil. or Ph.D. programmes.

Programme Summary

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
Semester I				
CH 501	Fundamentals of Analytical Methods	45	-	3
CH 502	Instrumental Analysis	30	30	3
CH 503	Spectroscopic Methods	45	-	3
CH 504	Environmental Analytical Chemistry	15		1
CH 511	Advanced Analytical Chemistry Laboratory I – Classical Methods		70	2
Semester II				
CH 516	Analytical Separations	30	-	2
CH 517	Electroanalytical Chemistry	30	-	2
CH 518	Special Topics in Analytical Chemistry I *	45	-	3
CH 519	Special Topics in Analytical Chemistry II *	45	-	3
CH 526	Advanced Analytical Chem. Laboratory II – Instrumental Methods		100	3
CH 596	Research Methodology and Scientific Writing	15	-	1
CH 597	Seminar			1
CH 599	Research Project			6

* *Optional courses. Students are required to obtain 3 credits from optional courses.*

6. PROGRAMME CONTENTS

CH 501: Fundamentals of Analytical Methods (3 Cr, 45 hrs)

Statistics and chemometrics: statistical calculations, confidence limits, tests of significance, correlation coefficient, propagation of error; sampling methods: representative samples, automation of sampling and sample treatment; experimental design; quality control and assurance, interlaboratory testing; Fourier transformation methods in data analysis. (15 h)

Method of analysis: working curve, standard addition and internal standard methods; volumetric and gravimetric methods; quantitative aspects of colorimetry; theory of different types of titrations: acid-base, precipitation, redox, complexometric, nonaqueous, etc.; use of analytical and quality control methods in industry. (20 h)

Introduction to analytical sensors; automated method of analysis; continuous flow methods; flow injection analysis; kinetic methods of analysis; miscellaneous methods: turbidimetry, refractometry, polarimetry, optical rotatory dispersion and circular dichroism. (10 h)

CH 502: Instrumental Analysis (3 Cr, 30 hrs lec + 30 hrs lab)

Elementary electronics: semiconductors, semiconductor diodes and transistors, power supplies and regulators, operational amplifiers, amplification and measurement of transducer signals, digital electronics, digital and analogue signals, readout devices, experiments on the above topics.

Spectroscopic instrumentation: components and materials for spectroscopic instrumentation, radiation sources, laser action, wavelength selectors, monochromators, sample containers, radiation detectors, signal processors and readout devices, fibre optics, experiments on the above topics.

Computer applications in chemistry: theory and applications of computer technology as applied to chemical analysis, experiments on the above topics.

CH 503: Spectroscopic Methods (3 Cr, 45 hrs)

A broad treatment of the interaction of electromagnetic radiation with matter, emphasizing atomic, molecular, rotational, vibrational & electronic spectra, selection rules, and relevant analytical applications.

Atomic absorption, emission & fluorescence spectroscopy: Principles of atomic spectroscopy; instrumentation of flame and electro-thermal atomization; atomic emission based on plasma, arc and spark atomization, and their analytical applications. (10 h)

Molecular spectroscopy: ultraviolet and visible spectroscopy; fluorescence, phosphorescence, and chemiluminescence spectroscopy; vibrational (IR and Raman) spectroscopy; analytical applications. (10 h)

X-ray methods: Principles of x-ray powder/single crystal diffraction (XRD). Reciprocal lattice constructions, and the rotating crystal method. JCPDS and other databases, and their applications; Principles of X ray fluorescence spectroscopy (XRF), wave dispersive and energy dispersive x-ray fluorescence spectroscopy, treatment of matrix effects and quantitative methods of XRF analysis. (10 h)

Electron-matter interactions: scanning electron microscopy (SEM), magnetic electron lenses, electron optical systems, sample preparation, thin foil techniques, and photography. Electron probe microanalyzer; introduction to next generation x-ray analytical methods. (5 h)

Nuclear magnetic resonance (NMR) and mass spectroscopy in chemical analysis. (10 h)

CH 504: Environmental Analytical Chemistry (1 Cr, 15 hrs)

Global environmental problems; air pollution; sampling of air, water and soil for chemical analysis; monitoring techniques of air pollutants, air quality standards, pollutants standards index (PSI), monitoring of volatile organic compounds; water pollution: water quality parameters and their determination, algal blooms and algal toxins, monitoring pesticide residues in water and soil, water treatment: municipal water treatment, waste water treatment methods.

CH 511: Advanced Analytical Chemistry Laboratory I - Classical Methods (2 Cr, 70 hrs)

Experiments on measurements and errors, sampling, chemometry, and classical analytical methods (volumetry, gravimetry, etc.); classical methods in environmental analysis.

CH 516: Analytical Separations (2 Cr, 30 hrs)

Theory of solvent extraction and phase equilibria, as applied to analytical separations; thermodynamic and kinetic aspects of separation; theory, instrumentation and analytical applications of gas chromatography, planar chromatography, liquid chromatography, size exclusion chromatography, ion chromatography, supercritical fluid chromatography; hyphenated methods; capillary electrophoresis.

CH 517: Electroanalytical Chemistry (2 Cr, 30 hrs)

Analytical applications of two-electrode systems: conductometry and potentiometry; controlled potential techniques: constant potential (e.g., amperometry), potential step (e.g., pulse techniques), and potential sweep methods (e.g., cyclic voltammetry); hydrodynamic methods; AC methods; bulk electrolysis methods: electrogravimetry, electrophoresis, electrosynthesis, coulometry, flow electrolysis, thin-layer electrochemistry; stripping analysis; hyphenated methods; electrochemical sensors; electrochemical technology.

CH 518: Special Topics in Analytical Chemistry I (3 Cr, 45 hrs)

Surface Analysis (15 hrs): Theory, instrumentation and applications of modern surface spectroscopic techniques such as X-ray photoelectron spectroscopy (XPS), Ultraviolet photoelectron spectroscopy (UPS), Auger electron spectroscopy (AES), Low-energy electron diffraction (LEED) and Electron energy loss spectroscopy (EELS).

Nanotechnology (15 hrs): Chemistry of nanosystems; preparation and characterization of nanosystems; analytical applications; sensors based on nanotechnology.

Forensic Chemistry and Toxicology (15 hrs): Forensic significance of physical evidence, analysis of contact traces, DNA fingerprinting, marks, impressions and fingerprints, basics of forensic/analytical toxicology, alcohol intoxication, drugs of abuse, agrochemical poisoning, plant poisoning & microbial toxins.

CH 519: Special Topics in Analytical Chemistry II (3 Cr, 45 hrs)

Pharmaceutical preparations and analysis (15 hrs): Preparation and characterization of pharmaceuticals; chemical analysis of drugs; quality control of drugs.

Food analysis (15 hrs): Quality control techniques; analytical techniques as applied to food industry.

Pesticide and pesticide residue analysis (15 hrs): Chemistry and classification of pesticides, degradation patterns, analytical methods for the detection of pesticides and their residues in the environment.

CH 526: Advanced Analytical Chemistry Laboratory II – Instrumental Methods (3 Cr, 100 hrs)

Experiments on instrumental methods of analysis, including spectroscopy, electrochemistry and separation; instrumental methods in environmental analysis.

CH 596: Research Methodology and Scientific Writing (1 Cr) (same as EN 525)

The nature and concepts of research, types of research and tools of research, research design and conceptualization, operationalization measurement and causality, survey of research and data collection techniques, strategies for data analysis and their applications, scientific and technical writing, writing research reports/thesis and scientific papers, compilation of bibliography, information gathering through internet and use of electronic resources.

CH 597: Seminar (1 Cr)

Each student is required to carry out a literature review of an analytical chemistry topic assigned to him/her and make a presentation. CH 592 should be completed within the first month of CH 599.

CH 599: Research Project (6 Cr)

The student will undertake a research project and other independent studies on full time basis for a period of six months. The candidate will be given the option of selecting a research problem in a preferred area that falls within the disciplines of the courses undertaken. The project could be conducted at the Department of Chemistry, University of Peradeniya, or at his/her working place if necessary laboratory facilities are available. For the latter option to be viable, a suitable person, holding postgraduate qualifications and willing to supervise the candidate, should be available at the workplace. In such instances, the research project should be jointly supervised by a staff member of the Department of Chemistry, University of Peradeniya. At the end of the project, the student is required to present his/her results in the form of a project report and make an oral presentation. Only a pass/fail grade will be given for CH 599.

7. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Hand Book.

8. PANEL OF TEACHERS

- Prof. H.M.N. Bandara, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Aston)
- Dr. W.M.A.T. Bandara, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (TIT)
- Dr. N.C. Bandara, Postgraduate Institute of Science, Univ. of Peradeniya
B.Sc. (Perad.), M.Sc. (New Orleans), Ph.D. (New Orleans)
- Prof. R.P. Gunawardhana, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Cey.), Ph.D. (Aberd.)
- Prof. O.A. Ileperuma, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Cey.), Ph.D. (Arizona)
- Dr. N. Kottegoda, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Cambridge)
- Dr. G.K. Manuweera, Registrar of Pesticides, Dept. of Agriculture, Peradeniya
B.Sc. (Perad.), M.Phil. (Perad.), Ph.D. (Missouri)
- Dr. M.M.A.N. Navaratne, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Hawaii)
- Prof. J.S.H.Q. Perera, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Brit. Col.)
- Dr. A.D.L.C. Perera, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (TIT)
- Prof. H.M.D.N. Priyantha, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Hawaii)
- Prof. R.M.G. Rajapakse, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (London)
- Mr. U.G. Somapala, Govt. Analyst Dept., Torrington Square, Colombo 07
B.Sc. (Perad.), M.Sc.
- Prof. D.T.B. Tennakone, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Wales)
- Mrs. D.A.S.S. Tennakoon, Govt. Analyst Dept., Torrington Square, Colombo 07
B.Sc. (Perad.), M.Sc. (London)
- Dr. Swarna Wimalasiri, Dept. of Food Science and Technology, Faculty of Agriculture, Univ. of Peradeniya
B.Sc. (Perad.), Ph.D. (Perad.)

9. PROGRAMME COORDINATOR

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