POSTGRADUATE INSTITUTE OF SCIENCE

UNIVERSITY OF PERADENIYA

M.Sc. in Industrial Chemistry 2011/2012

1. INTRODUCTION

Chemical industry has grown rapidly in recent decades, not only in terms of the tonnage produced, but also in the diversity of the products. These products are of vital importance in our everyday lives and it is extremely difficult to think of anything in the modern society, which does not involve chemistry at some stage of its manufacture. Clothing, food, drugs and building materials are few such examples. Ever increasing demand for these products has resulted in both expansion and diversification of chemical industry. A great majority of undergraduates leaving the universities at the end of their period of study seek employment in industry. In addition to possessing a sound background knowledge in Chemistry, they should be familiar with the special aspects of industrial chemistry and other allied subjects, which are useful to the industrialists in the field of chemical manufacture. Although some basic concepts in Industrial Chemistry are included in undergraduate courses they do not adequately meet the needs mentioned above.

2. OBJECTIVES OF THE PROGRAMME

To provide

- An adequate coverage of important aspects of Chemical Industry including Chemistry, Basic Concepts of Chemical Engineering, Chemical Technology and Industrial Economics.
- The necessary practical training in areas relevant to Chemical Industry.

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) B. Sc. Degree in Chemical Engineering.
(iii) 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, 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 $ 3000/-
Other countries	US $ 6600/-

Programme fees shall be paid in two instalments *(50% at the registration and the balance 50% 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.
Note: Candidates must have **either** a Chemistry **or** Engineering background. Those having neither will be required to pay an additional **Rs. 5000** to cover the extra credits.

5. THE PROGRAMME STRUCTURE AND DURATION

This programme is conducted by the Department of Chemistry of the Faculty of Science in collaboration with the Department of Chemical Engineering of the Faculty of Engineering. 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 Industrial Chemistry but not the M.Sc. Degree)*. Continuous attendance is compulsory during the period of research work. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree. Based on the performance by students in the taught courses, PGIS may upgrade the registration of such students to M.Phil. or Ph.D. programmes.

Programme Summary

Course Code	Course	Lecture hrs.	Practical hrs.	No. Of Credits
Semester I				
CH 529	General Analytical Chemistry	15	-	1
CH 530	Analytical Spectroscopy	30	-	2
CH 531	Chemical Engineering +	15	-	1
CH 532	General Chemistry ++	15	-	1
CH 533	Catalysis and surface analysis	30	-	2
CH 534	Heat Exchangers, Unit operations in Chemical Engineering	45	-	3
CH 541	Pilot Plant Studies (Laboratory Course I) +	-	30	1
CH 545	Environmental Management Systems	15	-	1
Semester II				
CH546	Environmental Pollution Control	30	-	2
CH 547	Materials Science, R & D, New Product Development and Industrial Economics, Estimation of Physical Properties	45	-	3
CH 548	Quality Control	15	-	1
CH 549	Energy Management	15	-	1
CH 550	Industrial Hazards and Safety	15	-	1
CH 552	Optional Topics (3 courses 15 hrs each)	45	-	3
CH 556	Physical Chemistry Practicals ++	-	30	1
CH 596	Research Methodology and Scientific Writing	15	-	1
CH 597	Seminar			1
CH 599	Research Project (4 months)			6

\+ *Only for those who have no Engineering background*

++ *Only for those who have no Chemistry background*

6. PROGRAMME CONTENTS

CH 529: General Analytical Chemistry *(1 credit, 15 hrs)*

Statistics and chemometry: statistical calculations; confidence limits; tests of significance; methods of analysis; 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)

CH 530: Analytical Spectroscopy *(2 credits 30 hours)*

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

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 database 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)

CH 531: Chemical Engineering (*1 credit, 15 hrs)*
(Only for those who have no Engineering background)
Selected topics in Chemical Engineering, Flow sheet analysis, transport phenomena (mass transfer, fluid flow and heat transfer).

CH 532: General Chemistry *(1 credit, 15 hrs)*
(*Only for those who have no Chemistry background*)
Introduction to General Chemistry, Calculations involving chemical formulae and equations, stoichiometry, states of matter, kinetic molecular theory, thermochemistry, reactions in aqueous solutions, phase equilibria, chemical kinetics and chemical equilibria.

CH 533: Catalysis and surface analysis *(2 credits, 30 hrs)*
Principles of homogeneous and heterogeneous catalysis, parameters important in determining catalytic activity, industrially important catalytic processes, modern techniques for characterizing catalysts (5 hrs). Design of homogeneous and heterogeneous catalytic reaction systems, flow reactors and continuous stirred tank reactors (10 hrs)
Surface Analysis
Theory, instrumentation and applications of modern surface spectroscopic techniques such as X-ray photoelectrion spectroscopy (XPS), Ultraviolet Photoelectron Spectroscopy (UPS), Auger Electron Spectroscopy (AES), Low-energy Electron Diffraction (LEED), Electron Energy Loss Spectroscopy (EELS) Employment of GC for monitoring of catalytic reactions. Surface characterization methods for the catalysis.(15 h)

CH 534: Heat Exchangers, Unit Operations in Chemical Engineering *(3 credits, 45 hrs)*
Boilers, Energy and energy conservation, Concept of unit operations, Heat and mass balances, distillation, extraction, drying, crushing, grinding, absorption, cooling, evaporation, boiling and condensation and equipment theory.

CH 541: Pilot Plant Studies (Laboratory Course I) *(1 credit, 30 hrs)*
(*Only for those who have no Engineering background*)
Bubble cap tray, Cooling tower, Winklemann's experiment, Vapour-liquid equilibria, Absorption column, Distillation column, Filter press, Drying experiment, Evaporator

CH 545: Environmental Management Systems *(1 credit, 15 hrs)*
(*Same as the second unit of CH 518*)
Cleaner Production: introduction, advantages, waste audit procedure, pre-assessment, material balance, synthesis, economic evaluation of alternatives, waste audit, process data, environmental data, financial data, searching for cleaner production options, waste reduction options and action plan, databases, selected examples, life cycle assessment, calculations for actual examples.
Environmental management and sustainable development: Standards, trade and the environment, purpose of environmental management, ISO 140001 in organizations, environmental code, laws and ethics.

CH 546: Environmental Pollution Control *(2 credits, 30 hrs)*
Noise pollution (3 hrs): Sources, measurement, regulations and control.
Air pollution (9 hrs): Types of air pollutants and there sources, measurements, regulations control techniques such as gravity settlers, cyclone separators, scrubbers, incinerators, filters.
Water pollution (9 hrs): Types and sources of water pollutants, Measurement and control techniques.

Solid and hazardous waste (9 hrs): Types, sources, minimization of generation, storage, handling and transportation, regulations.

CH 547: Material Science (1 credit, 15 hrs), **R & D, New Product Development and Industrial Economics** (1.4 credits, 21 hrs), **Estimation of Physical Properties** (0.6 credit, 9hrs)

Material Science: Classification and properties of solids, preparation and reactions of solid materials, characterization techniques, chemistry of semiconductors and superconductors, corrosion and protection of solid materials, electrical and optical properties of materials, mining and metallurgy.

R & D, New Product Development and Industrial Economics: Industrial research and development, organization, chemical intermediates, patents, technology licensing, project selection, new product development, new products, elements of cost, materialism energy and labour, variable and fixed costs, overheads, marginal costs, contribution, profitability, process integration, capital cost estimation, dependence on process and scale of operation, contracts, pricing of new products, measurement of performance, value added, assts, cash flow, project evaluation, payback time, sensitivity and risk analysis, standards of profitability, dealing with inflation.

Estimation of Physical Properties: Estimation of physical properties of compounds – Density, viscosity, thermal conductivity, specific heat capacities, latent heat, vapour pressure, diffusion coefficient, surface tension, critical constants and phase equilibrium data.

CH 548: Quality Control *(1 credit, 15 hrs)*

Basic concepts of quality and quality control; Relationship between quality and productivity, costs and value; Quality control and process management; Introduction to statistical quality control; The basics of Total Quality Management.

CH 549: Energy Management *(1 credit, 15 hrs)*

Renewable and non-renewable sources of energy in industry (1 hr); Conservation of energy and waste heat recovery (3 hr); Energy planning and management (5 hr); Principles of energy auditing with practical examples (6 hr).

CH 550: Industrial hazards and safety *(1 credit, 15 hrs)*

General hazards in the industry, methods for minimizing risk, safety in chemical process, plant design and operation, chemical safety in R & D, employee responsibility, identification and assessment of hazards.

CH 552: Selected Topics in Industrial Chemistry *(3 credits, 45 hrs, each course 15 hrs)*

Three courses from the following topics have to be taken. Only 5 of these topics will be offered in any one year. Topics available will be announced at the start of the programme.

1. Ceramic Industry
2. Crop Processing Technology
3. Fermentation Technology
4. Food Technology
5. Paint and Varnish Industry
6. Paper and Wood Technology
7. Petrochemical Industry
8. Pharmaceutical and cosmetic Industry
9. Polymer Industry
10. Textile Industry

11. Leather Industry
12. Laboratory Management
13. Coconut Industry
14. Tea Industry
15. Rubber Industry

CH 556: Physical Chemistry Practicals (Laboratory Course II) *(1 credit, 30 hrs)*
Only for those who have no Chemistry background
Kinetics of homogenous and heterogeneous reactions, Sorption of gases at catalyst surfaces, separation techniques, water quality measurements, electroplating.

CH 596: Research Methodology and Scientific Writing *(1 credit, 15 h)*
The nature and concepts of research, types of research and tools of research, research design and conceptualization, operationalization measurement and causality, survey research and data collection techniques, strategies for data analysis and their applications, scientific writing and writing research reports/thesis, preparation of bibiliography, information gathering through internet and use of electronic resources.

CH 597: Seminar *(1 credit)*
Each student is required to conduct an independent study on a topic in Industrial Chemistry assigned to him/her, submit a report and make an oral presentation.

CH 599: Research Project *(6 credits, minimum of 4 months duration)*
Each M.Sc. student is required to work on a suitable experimental design related to Industrial Chemistry for a period of not less than three months. This must be assigned to the candidate by his/her research supervisor. The project could be conducted at the Department of Chemistry/Chemical Engineering or any other approved organization acceptable by the Board. However, in the latter case the work has to be supervised by an external supervisor at the training place, in addition to a supervisor from the department of Chemistry/Chemical Engineering. At the end of the research project the candidates are required to present their results in the form of a dissertation and a seminar.

7. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Hand Book 2002.

8. PANEL OF TEACHERS

Dr. I.S.B. Abeysinghe, Tea Research Institute, Talawakelle
B.Sc. (Perad.), Ph.D. (Shefield)
Dr. A.A.P. de Alwis, Dept. of Chemical Engineering, University of Moratuwa, Katubedda, Moratuwa *B.Sc. Eng. (Moratuwa), Ph.D. (Cambridge)*
Prof. H.M.N. Bandara, Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya
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Mr. Senerath Ekanayake, Food Scientist, Food Research Division, Department of Agriculture, Peradeniya *B.Sc. (Perad.), M.Sc. (Mysore)*

Dr. K.D.P. Hemalal, Hemas Manufacturing, Negombo Road, Welisara.
B.Sc. (Col.), M.Phil. (Col.), Ph.D. (OUUK)

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9. PROGRAMME COORDINATORS

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