UNIVERSITI MALAYA

Student Handbook 2019/2020

Master of Science

Instrumental Analytical Chemistry

Department of Chemistry

Faculty of Science • University of Malaya

Disclaimer

Although the information in this Handbook is accurate at the time of publication, aspects of the programme may be subject to modification and revision. The Department reserves the right to modify the programme in unforeseen circumstances, or where the process of academic development and feedback from students, quality assurance processes or external sources, such as professional bodies, requires a change to be made. In such circumstances, revised information will be issued. Information provided by the Department in the course of the year should therefore be regarded, where appropriate, as superseding the information contained in the handbook.

Content

A message from the Head of Department

Professor Dr. Sharifuddin Md Zain

Welcome to the Department of Chemistry, University of Malaya. We are pleased that you have selected to study here and we hope that your time here will be exciting and enjoyable. The excellent education you will receive here will be a valuable stepping stone in both your continuing education and the further development of your career.

The Department of Chemistry is the largest department in the Faculty of Science. The department started operation in the academic year 1959/1960 and is one of the oldest departments in the faculty. One of the objectives of the department is to provide a centre of excellence in chemical education and research in Malaysia. Students from the department are trained to develop their critical, creative and innovative thinking. The department is proud to produce graduates who are highly regarded and much sought after in the work force market. We have many notable graduates who go on to make careers in leading position in government agencies, business and international organizations in Malaysia and across the world.

We hope you will find this MSc handbook a useful resource and source of information about your courses. Our staff in the Department of Chemistry office will be very pleased to help you with other queries you may have.

Wishing you all the best in your studies and a very successful year with us.

Department of Chemistry

The Department of Chemistry is the largest department in the Faculty of Science. The department started operation in the academic year 1959/1960 and is one of the oldest departments in the faculty. One of the objectives of the department is to provide a centre of excellence in chemical education and research in Malaysia. Students from the department are trained to develop their critical, creative and innovative thinking. The department is proud to produce graduates who are highly regarded and much sought after in the work force market. At the moment, the Departmental workforce consists of 52 academic staff and 44 support staff who are involved in either technical or clerical support roles.

The Department offers three programmes, namely, the Bachelor of Science in Chemistry (B.Sc. in Chemistry), Bachelor of Science in Applied Chemistry (B.Sc. in Applied Chemistry) and Master of Science in Instrumental Analytical Chemistry (M.Sc. in Instrumental Analytical Chemistry) (formally known as Master of Science in Analytical Chemistry & Instrumental Analysis). The Department is the first institution of higher learning in Malaysia to receive the Royal Society of Chemistry (RSC) accreditation for all BSc and MSc programmes. Benchmarking the three offered programmes with those offered by other renowned institute of higher learning via the RSC accreditation would certainly help the Department to develop and expand its programmes in line with international quality and standards.

The Department of Chemistry also offers postgraduate programmes by research, namely, Master of Science by research, Master and Doctor of Philosophy. These programmes form the essence of our research activities. The research conducted in the Department is varied; some researchers focus on fundamental themes while others focus on various aspects of applied chemistry.

Introduction

This is the Student Handbook for the MSc programme in *Instrumental Analytical Chemistry.* This Handbook provides basic information that you need for this programme. It contains information about the facilities, the host departments, the main procedures to be followed, and references to further sources of information. It is a good idea to read the handbook through before you start your time at the Department of Chemistry. Please note that no handbook can cover every possible contingency; If you can't find an answer from this handbooks, please contact:

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Note: The information in this Handbook is believed to be correct at the time of printing, but may be subjected to change during the year. Further information can be obtained from the Department's website (http://fs.um.edu.my/department-institute/department-of-chemistry). Students will be informed of any changes to this Handbook, or any further information regarding the Programme, by email or by notices in the relevant location.

List of Academic Staff

Head of Department

Prof Dr. Sharifuddin M Zain, *BSc(Lond), ARCS, PhD (Lond), DIC*

Professor

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Aziz Hassan, *MSc (UMIST), PhD(Brunel)*
Khalijah Awang, *BSc (Waterloo), MSc, PhD(Paris)*
Misni Misran, *BSc (Flinders), PhD(East Anglia)*
Noorsaadah Abd. Rahman, *BA, MSc, PhD(Cantab)*
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Associate Professor

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Hairul Anuar Tajuddin, *BSc, MSc (Mal), Phd (Sheff)*
H.N.M Ekramul Mahmud, *BSc, Msc, (Dhaka), PhD(UPM)*
Siti Nadiah Abd. Halim, *BSc, MSc, PhD (Bristol)*
Ninie Suhana Abd. Manan, *BSc, MSc (UM), PhD (Belfast)*
Nor Kartini Abu Bakar, *BSc, PhD(Wales), MRSC, CChem*
Sharifah Mohamad, *BSc, MSc (Mal), PhD (UPM)*
Thorsten Heidelberg, *Dipl Chem, PhD(Hamburg)*

Senior Lecturer

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Arniza Khairani Mohd Jamil, *BSc, PhD(Queensland)*
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Choo Yeun Mun, *BSc, MSc, PhD(UM)*
Desmond Ang Teck Chye, *BSc, PhD(UM)*
Iskandar Bin Abdullah, *BSc, PhD(UM)*
Khor Sook Mei, *BSc, MSc(UKM), PhD(UNSW)*
Lim Siew Huah, *BSc, MSc, PhD (UM)*
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Siti Munirah Binti Saharin, *BSc, MSc, PhD(Japan)*
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Tay Kheng Soo, *BSc, MSc, PhD(UM)*
Teo Yin Yin, *BSc, MSc, PhD(UM)*
Woi Pei Meng, *BSc, MSc(UPM), PhD(UM)*

Programme Information

Introduction of Programme

The Masters of Science in Instrumental Analytical chemistry which was formally known as Master of Science in Analytical Chemistry & Instrumental Analysis is a MSc by coursework programme. Formal Master of Science in Analytical chemistry & Instrumental Analysis is a Royal Society of Chemistry (RSC, United Kingdom) accredited program. RSC is one of the world's leading professional associations. The RSC accreditation is a rigorous evaluation process that is respected around the world. The accreditation of our programme by RSC is a strong recognition of the excellent standards and high quality education that the Department of Chemistry offers to our students.

Analytical Chemistry is one of the largest employment area for the Chemical Sciences. This programme gives you a boost to your knowledge in modern analytical instruments and techniques required to increase your employability. You will receive comprehensive, hands-on and training with modern Analytical techniques and instrumentation such as Gas Chromatography, High Performance Liquid Chromatography, Mass spectrometry, Nuclear Magnetic Resonance Spectroscopy, Atomic Absorption Spectroscopy, etc.

Aims

The aim of the Masters (Coursework) in Instrumental Analytical chemistry is to cater for the growing needs of modern day industry which require skilled personnel who are knowledgeable in the handling of a sophisticated range of materials characterization instruments as well as possessing the interpretative skills necessary to solve complex chemistry problems. The course is based on modern instrumental analytical chemistry and is designed to address the needs of industrial laboratories and research organizations.

Admission Requirements

Applicants should possess one of following:

1. Bachelor of Science with Hons (CGPA 3.00 and above) in Chemistry or its equivalent in the related field, **or**
2. Bachelor of Science in Chemistry or its equivalent in related field with a minimum of three (3) years of working experience as a practicing chemist, **or**
3. Bachelor degree or its equivalent in a science-related discipline with at least three (3) year working experience as a practicing chemist.

Language Requirements

The medium of instruction is in English. International students are required to attend and pass a basic course in Bahasa Melayu before the degree can be conferred. If they intend to write their dissertation/thesis in English they must possess at least band 6 IELTS or a score of 550 TOEFL if they had obtained their Bachelor's degree from a university in which the medium of instruction is other than English.

Programme Structure

Nature of the Programme

- Coursework - 75% and Research project - 25%

Period of Candidature

- 2 semesters (minimum); 8 semesters (maximum)

Structure of Programme

Each candidate is required to fulfill **42** credit hours by **12** courses as follows:

1) 9 core courses including Research Methodology in Analytical Chemistry, Research Project and Advanced Laboratory Skill (33 credit hours)
2) 3 Elective courses (9 credit hours)

Note: 1 credit hour is equivalent to 1 lecture hour/week/semester. 1 semester is equivalent to 14 weeks.

Assessment

A candidate is deemed to have passed the written examination if he/she obtains an overall CGPA $\geq$ 3.00. The MSc degree is awarded to candidates who gain a CGPA of 3.00 or more. Distinction will be awarded to candidates whose work is considered by examiners to be truly outstanding.

List of Courses

COURSE CODE	COURSE	CREDIT HOUR
Core courses*		
SQC7001	Research Methodology in Analytical Chemistry	4
SQC7002	Research Project	10
SQC7003	Atomic Spectroscopic Analysis	3
SQC7004	Chromatographic Analysis	3
SQC7005	Quality Assurance in Analytical Laboratory	3
SQC7006	Molecular Spectroscopic Analysis	3
SQC7007	Mass Spectrometry and Related Techniques	3
SQC7008	Advanced Laboratory Skills I	2
SQC7009	Advanced Laboratory Skills II	2
Elective courses**		
SQC7010	Electroanalytical Chemistry and Biosensor	3
SQC7011	Laboratory Automation	3
SQC7012	Thermal Analysis	3
SQC7013	Chemometric	3
SQC7014	Environmental Chemical Analysis	3
SQC7015	Food Analysis	3
SQC7016	Particulate and Surface Analysis	3

* Compulsory courses
** Students are required to select 3 courses from the Elective Courses

Grading system

MARKS	GRADE	GRADE POINT	GRADE DEFINITION
90 - 100	A+	4.0	Excellent
80 - 89	A	4.0	Distinction
75 - 79	A-	3.7	
70 - 74	B+	3.3	Pass
65 - 69	B	3.0	
60 - 64	B-	2.7	
55 - 59	C+	2.3	
50 - 54	C	2.0	
45 - 49	C-	1.7	Fail
40 - 44	D+	1.5	
35 - 39	D	1.0	
0 - 34	F	0.0	

How to calculate your GPA and CGPA?

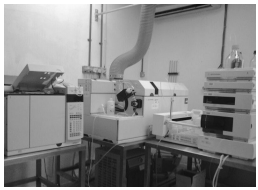
The Grade Point Average (GPA) is an internationally recognised calculation used to find the average result of all grades achieved for your course at particular semester. CGPA stands for Cumulative Grade Point Average. It is the average of Grade Points obtained in all the subjects including the Research Project.

$$\text{CGPA / GPA} = \frac{\sum(\text{Grade Point} \times \text{Credit hour})}{\sum(\text{Credit hour})}$$

University of Malaya,
Academic Calendar for 2019/2020 session

SEMESTER I		
Introduction Week	1 week	01.09.2019 - 08.09.2019
Lectures	8 weeks	09.09.2019 - 03.11.2018
Mid-Semester Break	1 weeks	04.11.2019 - 10.11.2019
Lectures	6 weeks	11.11.2019 - 22.12.2019
Revision Week	1 week	23.12.2019 - 29.12.2019
Examination	3 weeks	30.12.2019 - 19.01.2020
Semester Break	4 weeks	20.01.2020 - 16.02.2020
	24 weeks	
SEMESTER II		
Lectures	9 weeks	17.02.2020 - 19.04.2020
Mid-Semester Break	1 week	20.04.2020 - 26.04.2020
Lectures	5 weeks	27.04.2020 - 31.05.2020
Revision Week	1 week	01.06.2020 - 07.06.2020
Examination	3 weeks	08.06.2020 - 28.06.2020
	19 weeks	
SESSION BREAK		
Session Break	11 weeks	29.06.2020 - 13.09.2020

Course Description



SQC7001

Research Methodology in Analytical Chemistry

Course Description

This course provides an overview of research methodology in the field of chemistry and the introduction of basic statistical techniques for data analysis. Topics discussed include scientific problem solving techniques and experimental planning, research ethics and laboratory safety, literature study and scientific writing, sampling plans and strategies, data treatment and analysis which involve basic statistics, hypothesis tests and regression.

Sample treatment-Introduction & general considerations on sampling techniques & sample decomposition; sources of errors in decomposition and dissolution; wet oxidation and dry oxidation methods; decomposition of samples by fluxes, microwave and ultrasonic; relative merits of each sample decomposition method; metal speciation in biological and environmental analysis.

Sample preparation for Organic Analysis – Extraction methods for solids, liquids and volatile compounds; Pre-concentration using solvent evaporation; Clean-up and coupling of different sorbents; effect of sample matrix; Advantages and drawbacks of extraction methods. Examples of case studies related to selective methods on organic and inorganic analysis.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7002

Research Project

Course Description

The student would perform research under the supervision of Department of Chemistry's lecturer in his/her chosen research project. The findings of the project would be presented in a report at the end of the second semester. This report would then be assessed by the supervisor and an internal examiner appointed by the department.

Course Assessment

Continuous Assessment: 100% (Based on submission of a written report and presentation)

SQC7003

Atomic Spectroscopic Analysis

Course Description

The module is designed to introduce the general aspects on atomic spectroscopy, flame and plasma atomic emission spectrometry (AES), atomic absorption spectrophotometry (AAS), including non-flame AAS and hydride-generation technique, atomic fluorescence spectrometry (AFS), molecular fluorescence spectrometry (MFS) and inductively coupled plasma (ICP). Atomic absorption spectroscopy (AAS) is a spectroanalytical procedure for the quantitative determination of chemical elements using the absorption of optical radiation (light) by free atoms in the gaseous state. Atomic emission spectroscopy (AES) is a method of chemical analysis that uses the intensity of light emitted from a flame, plasma, arc, or spark at a particular wavelength to determine the quantity of an element in a sample. The wavelength of the atomic spectral line gives the identity of the element while the intensity of the emitted light is proportional to the number of atoms of the element. Fluorescence spectroscopy (also known as fluorometry or spectrofluorometry) is a type of electromagnetic spectroscopy which analyzes fluorescence from a sample. It involves using a beam of light, usually ultraviolet light, that excites the electrons in molecules of certain compounds and causes them to emit light; typically, but not necessarily, visible light. An inductively coupled plasma (ICP) is a type of plasma source in which the energy is supplied by electric currents which are produced by electromagnetic induction, that is, by time-varying magnetic fields. Topics to be discussed in this module will include spectro-chemical information such as spectrochemical measurements, optical components of spectrometers, optical sources, transducers and measurement systems, signal-to-noise ratio considerations and methodology in spectro-chemical analysis.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7004

Chromatographic Analysis

Course Description

Gas chromatography (GC) is one of the most widely used analytical techniques. GC is used to separate complex mixtures of different molecules based on their physical properties, such as polarity and boiling point. It is an ideal tool to analyze gas and liquid samples containing many hundreds or even thousands of different molecules, allowing the analyst to identify both the types of molecular species present and their concentrations. The course content includes: general principle of GC, sample injection techniques, column and column selection, theory of separation, detectors, qualitative and quantitative analysis using GC and some basic applications of GC.

High-performance liquid chromatography (HPLC) is a chromatographic technique used to separate a mixture of which is non-volatile. HPLC play an important and critical role in the field such as pharmaceutical and food industries. The importance of HPLC uses in pharmaceutical industries falls under the stringent regulations established by the U.S. Food and Drug Administration (FDA). This require all pharmaceutical companies to detect the quality of their products by using the HPLC before allowing them to sell it in the global market. The course content includes: basic theory of liquid chromatography, sample injection, major components of HPLC, mode of HPLC, mobile phase, column and column selection, theory of separation, detectors, basic troubleshooting, qualitative and quantitative analysis using HPLC.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7005

Quality Assurance in Analytical Laboratory

Course Description

This course provides an overview on the following topics:

- Introduction to quality assurance in analytical laboratory
- Quality Management – Introduction to quality systems; quality assurance principles; certification and accreditation
- Technical Issues – Quality assurance/quality control tools; calibration; metrological traceability; measurement uncertainty; method validation; inter-laboratory studies and reference materials

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7006

Molecular Spectroscopic Analysis

Course Description

This course provides an overview on the following topics:

Basic optical theory; Optical methods of analysis, Absorption and emission spectra; ultra-violet/visible spectroscopy (basic theory, instrumentation, interpretation of spectra and application); Infrared spectroscopy including NIR (Basic theory, instrumentation, FT-Infrared spectroscopy; interpretation of spectra and applications, quantitative infrared analysis, sampling techniques, reflectance techniques); Raman spectroscopy (Raman effect, instrumentation and applications).

General introduction to the theory of Nuclear Magnetic Resonance spectroscopy which includes chemical shift, spin-spin coupling, spin relaxation, NMR hardware, 1H and 13C NMR and other multinuclear species. Aspects of application including spectra analysis (1D and 2D NMR data, structure elucidation), paramagnetic behaviour, and low temperature NMR.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7007

Mass Spectrometry and Related Techniques

Course Description

This course provides an overview on the following topics:

- Introduction of mass spectrometry including the concept and some important terminology used in mass spectrometry, and application.
- Basic Instrumentation of mass spectrometer including types of analyser and ion detectors.
- Advance mass spectrometry: MS/MS - Concept and definitions, ion dissociation, instrumentation and analyte identification.
- Principle of Ionization modes (EI, CI, ESI, and MALDI) and data interpretation.
- Instrumentation Interfaces in mass spectrometry, including GC-MS and LC-MS.
- Data interpretation

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7008 Advanced Laboratory Skills I
SQC7009 Advanced Laboratory Skills II

General Information

Advanced laboratory skill is laboratory work where students are required to carry out experiments in laboratory. Grade will be given based on laboratory performance and the laboratory report. Students who enrol in this programme are required to register both of these courses. SQC7008 and SQC7009 will be offered in Semester I and Semester II, respectively. Laboratory session will be held on every **Friday, 10 am to 5 pm**. Each student is required to attend 42 hours (equivalent to 7 days) of laboratory session. Laboratory session is divided in to two cycles. First cycle will be held on Week-1 to Week-7 and the Second cycle will be held on Week-8 to Week-14.

Course Description

SQC7008 and SQC7009 practical courses consist of a number of mini projects covering different aspects of the subject. The emphasis is to provide training in the analytical approach for the total analysis of samples of very different natures. It is hoped that students would gain valuable experience in a variety of both common and specialized techniques in following certain appropriate procedures in solving certain analytical problems of current interest.

Students are advised to choose any two projects (from two different groups) and should plan to complete each project in about 20 hours. Once you have made the choice, students are required to look up for relevant literature, plan your experimental work and discuss the findings with the lecturer-in-charge of the class before proceeding any further.

Course Assessment

Laboratory skill and report (100%)

SQC7010

Electroanalytical Chemistry and Biosensor

Course Description

Part 1 (Electroanalytical Chemistry)

- Review of basic concepts in electrochemical analysis; Equilibrium (static methods) - potentiometry, pH, reference electrodes, liquid junction potentials, ion selective electrodes, potentiometric titrations.
- Dynamic methods - sweep and pulse techniques, hydrodynamic and differential techniques.

Part 2 (Biosensors)

- Basics of biosensors and nanotechnological approaches to biosensor development.
- Basics of Biosensors - What is a biosensor, steps involved in making a biosensor, the sorts of biomolecules used in biosensors; methods of immobilizing biomolecules; approaches to transduction and classes of biosensors.
- Catalytic Biosensors - Two models on enzyme electrodes: First model: immobilizing the enzyme in a polymer layer; The second model: enzyme biosensors using self-assembled monolayers.
- Affinity Biosensors - such as DNA and antibodies.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7011

Laboratory Automation

Course Description

This course provides an overview on the concepts of laboratory automation from the aspects of financial justification; project management; laboratory process flow and the use of technologies to increase efficiency and effectiveness of laboratory operations; Introduction to the aspects of data acquisition; the technologies involved in data acquisition and laboratory informatics. This course exposes students to the various aspects of lab automation endeavours. These include:

- Introduction to laboratory automation
- Managing a lab automation project
- Process flow in laboratory automation and its optimization
- The concept of lab unit operation and robotics in lab automation
- Data acquisition, networking and AIDC (Automatic Identification and Data Capture)
- Laboratory information management system
- Instrument interfacing data systems

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7012

Thermal analysis

Course Description

Thermal analysis (TA) describes the analytical experimental techniques which investigate the behaviors (such as weight, length, modulus, heat flow, temperature, enthalpy, dimension etc.) of a sample as a function of temperature. TA techniques can investigate both the physical phenomena (such as the changes in crystallographic properties, melting, sublimation, adsorption etc.) and chemical phenomena (such as dehydration, decomposition, oxidation, reduction etc.) of a material.

In general, TA techniques (such as Differential Scanning Calorimetry, Thermal Gravimetric Analysis, Differential Thermal Analysis, Dynamic Mechanical Analysis and etc.) are used for the qualitative and quantitative analyses of macromolecules and inorganic compounds. Students will be exposed to the theories, instrumentation, operations and applications of some TA techniques. Applications of these techniques in conjunction with other methods of analysis will also be discussed.

Specific topics on the transitions and relaxations of amorphous and crystalline materials, particularly polymers, will be included. Students will develop skills in monitoring the instrumental parameters and data analysis through the presentation of some specific case study. The knowledge gained from this course will be beneficial for the students when TA becomes a part of their job in real life.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7013

Chemometric

Course Description

Chemometrics is the use of mathematical and statistical methods to improve the understanding of chemical information and to correlate quality parameters or physical properties to analytical instrument data This course provides a practical guide to solving scientific problems using chemometric tools. Topics discussed are organized in three main parts:

Part I – Design of experiments

Part II – Pattern Recognition

Part III – Calibration

including concepts and key applications.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7014

Environmental Chemical Analysis

Course Description

Interest in the environment continues to expand and develop. It is now very much part of our everyday lives. As a consequences, the need for chemical analysis of the environment continues to grow. This course gives an overview on the following topics:

- Environment and pollution, and the Transport of pollutants in the environment and approaches to their analysis
- Water analysis — Major parameters (pH, electrical conductivity, TOC, BOD, COD, DO, turbidity, total solid, alkalinity, hardness and etc)
- Trace pollutants (radionuclide, organic and inorganic)
- Analysis of land, solids and waste (common problem areas and considerations for analysis in sediments, soils, sewage sludge, plant and animal specimens)
- Atmospheric analysis (Gases and particulates)

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7015

Food Analysis

Course Description

This module would cover the main analytical techniques used in the food industry for the analysis of a range of food parameters. It would explore the analysis of fat soluble and water soluble vitamins, dietary fibers in food components, pesticide residues in food products, trace minerals in natural and processed foods, food additives and preservatives, micronutrients in the food chain, food contaminants , and food flavors using the various techniques described in the basic package. HACCP procedure would also be introduced for food safety evaluation programe by the food manufacturers. Evaluation of techniques by comparison with alternative methods would be presented to illustrate the limitations of the techniques and their fields of application.

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%

SQC7016

Particulate and Surface Analysis

Course Description

The course aims to provide students a good understanding into colloidal domains, surface interfaces and analyzing properties of such systems. Students will be guided through introductory topics on particle dispersions, types of colloidal systems, and their applications. Others such as factors affecting particle suspension such as electrolytes, pH, hydrophobicity and hydrophilicity will also be inclused. Colloidal forces and dispersed phase properties such as concentration, size and surface properties such as surface charge and potential are crucial factor affecting the particulate systems. This course also explores topics typically relevance to industrial chemists and engineers working in areas such as coating, paints, textile, pigments, cements, pharmaceutical, foods, latex/ emulsions industries. The students will also learn a range of techniques for characterization of these systems.

Topics will be taught in the course are as follow,

Dispersion properties—Introduction to particles and colloidal suspension. colloidal stability, flow properties, viscosity and viscoelasticity, colloidal or surface forces such as AFM and SFA.

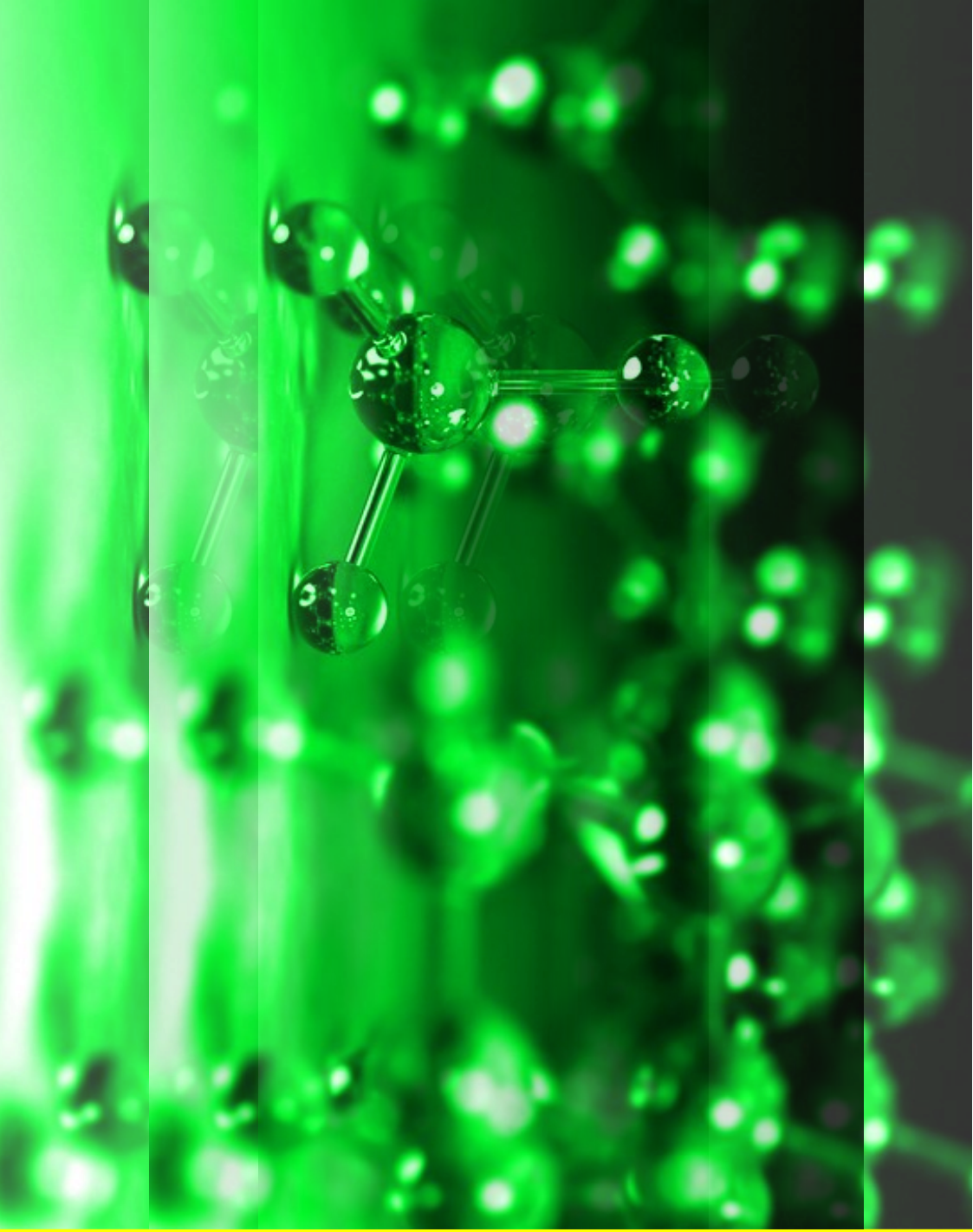
Surface Properties— Wettability (contact angle goniometer), surface and interfacial tension/energy (tensiometer).

Particulate properties Surface area (gas adsorption and BET), particle size distribution and shape (Laser light scattering), surface charges and surface potential, (Electrophoretic mobility, electroacoustic).

Course Assessment

Continuous Assessment: 50%

Final Examination: 50%



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