

SE-033

## **A NEW BREAKTHROUGH IN CHEMISTRY AND MANAGEMENT**

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### **ABSTRACT**

Chemistry program and management have been known in education around the world such as in UCL, Birmingham, Warwick universities, United Kingdom and Berkeley University in the United States by involving chemistry students into industry. The students are provided with chemistry and management courses that would make them highly competitive capabilities in the workplace especially in industrial worlds. First year and second year of studying, chemistry students would take similar core course with addition of two modules designed for specific purposes. This structure allows students to transfer to different degree programs at the last year of course, in which the students studied additional subjects at the first and second years. The student would get experiences of implementing chemistry in industrial context. They are actually would take a year longer than those who do not go to industry, but the content are similar to students who spent their school a year in industry.

**Key words:** *Chemistry, Industry, Management*

### **INTRODUCTION**

Introduction of management to chemistry students is viewed as a new breakthrough in chemistry education especially in developed countries such as, in the United Kingdom (Birmingham University, 2014; Warwick University, 2014; Kingston University, 2013, University of York, 2014) and the United States (Harris, and Altamirano, 2014; Berkeley University 2013).

Various chemistry programs introduced involves students to work in industries which give them higher opportunities to get jobs and implementing chemistry knowledge found in classrooms in the real industrial worlds. Chemistry as the center of science is responsible on a number of new breakthrough in science developments.

In a number of occasions, the most important thing in the world is discovery and innovative processes and new products, in which chemistry distribute a great impact in improving our daily life (Birmingham University, 2014; Warwick University, 2014; Harris, and Altamirano, 2014).

In business world, it is no doubt to get benefit from those who have certain specialty which was developed during scientific trainings, at the same time scientific world requires students who have experienced in business, therefore, students graduated from Chemistry and Business Management program would have a rarely highly combined skill in both disciplines of Chemistry and Business Management.

If you want to study in Birmingham and enroll in the most highly outstanding university in the United Kingdom, you would have accessed to a number of research facilities and the best learning resources available in the country.

At the same time students would continuously be challenged after passing a certain limit of comprehension, and everything will occur in a supportive environment of teaching learning circumstance. At the time students graduated, they would be ready to continue their carriers and developed a futuristic science in the society (Birmingham University, 2014)

Chemistry department of Imperial College London offers three years in Chemistry and Science Management and four years in Chemistry and Management courses to prepare students' carrier in management. For three years of course offers two years course in chemistry followed by one year course in Business course, and for the four years course offers students to take chemistry course for three years (similar to BSc Chemistry core syllabus) followed by one year course in Business course. For five years course includes students placing learning in industry at year end especially in Business. First year and second year students at this program, should take core courses in chemistry followed by two modules ancillary designed for a specific degree.

This structure allows students a lot of opportunities to transfer to a different course. By involving students in industry, would give them opportunities using chemistry in industrial context, as a result they would be provided with higher ability to work with in industrial world market after graduating (Chemistry department, Imperial college, 2014).

University College London (UCL) offers a BSc program in Chemistry with ideal Management studies, if the students consider carrier in Management and would like to develop management skills (UCL, 2014). The core course chemistry program is similar to BSc chemistry courses, and provides students with major aspects needed.

## **Various Chemistry and Management programs offered**

### **1. Chemistry and Drugs**

Course Structures

Courses

Content of the Chemistry in the first year and the second year are similar for all courses. This would allow students to transfer within other courses through a certain requirement according to selected ancillary course at the first of the academic year.

### **First Year**

List of Subjects offered at first year (core subjects)

- Chemical Reactivity
- Atomic Structure
- Introduction to Spectroscopy and Characterisation
- Mathematics for Chemistry I
- Aromatic Chemistry
- Chemical Equilibria
- Molecular Structure
- Periodicity
- Coordination Chemistry
- Stereochemistry
- Alkanes, Alkenes, Alkynes
- Haloalkanes, Alcohols, Amines
- Chemistry of Carbonyls and Carboxyls
- Chemical Kinetics
- States of Matter
- Quantum Chemistry I

Ancillary subjects

- Humanities options (e.g. Philosophy, Politics)
- Maths and Physics for Chemists I
- Chemical Engineering I
- Medicinal Biology

### **2. Chemistry with a Language for Science:**

Students would study language, history and politics in the selected country (i.e French).

### **3. Chemistry with Research Abroad (CRA);**

Students would generally select the appropriate language

### **4. Chemistry with Medicinal Chemistry (CMC):**

Students would take medicinal biology.

### **5. Chemistry with Molecular Physics (CMP) :**

Students would take math and physic for chemistry.

## Laboratory work

The course includes basic techniques, syntheses, workshop arrow and spectroscopy, and physical chemistry, informational technology for chemistry which introduces computer application in informational chemistry and molecular modeling.

## Second Year

List of Courses offered:

### Inorganic chemistry:

- NMR and EPR Spectroscopy
- Molecular Orbitals in Inorganic Chemistry
- Main Group Chemistry
- Transition Metal Coordination and Organometallic Chemistry
- Crystal and Molecular Architecture

### Organic and biological chemistry:

- Organic Synthesis I
- Hetero aromatics
- Biological Chemistry I
- Pericyclic Reactions
- Conformational Analysis

### Physical chemistry:

- Interfacial Thermodynamics
- Electrochemistry and Electrochemical Kinetics
- Statistical Thermodynamics
- Electronic Properties of Solids
- Mathematics for Chemistry II

### Ancillary subjects

- Languages (most of them are major in Europe available for all levels)
- Humanities options (e.g. Philosophy, Politics.)
- Management (various courses offered and carried out by the Imperial College.)
- Maths and Physics for Chemists II
- Chemical Engineering II
- Medicinal Chemistry
- Undergraduate Ambassador Scheme (UAS): chemistry learning techniques.
- **Chemistry with a Language for Science: students would take language and history, and science and technology from selected country (i.e French).**

6. **CRA** : Students would generally take advance language.

7. **CMC** : Students would take medicinal chemistry.

8. **CMP** : Students would take Math and Physics for Chemistry II

### **Laboratory Works**

This course Includes advance syntheses and symmetry techniques, and also introduction to electronic structure and statistical mechanics.

### **Third Year**

MSci course and Bsc course in chemistry (F100), Bsc chemistry with Management (F1NF), Chemistry with Management and one year overseas (FN11), and chemistry with science language (F1R1, F1R2, F1R4)

Course core – Term 1

#### **Inorganic chemistry:**

- Advanced Transition Metal Chemistry
- Advanced Main Group
- Inorganic Mechanisms and Catalysis
- Solid State Chemistry

#### **Organic chemistry:**

- Organic Synthesis II
- Polymers: the Essential Guide
- Introduction to Physical Organic Chemistry
- Introduction to Reaction Stereo-electronics

#### **Physical chemistry:**

- Modern Analytical Chemistry
- Quantum Chemistry II
- Photochemistry

Optional courses – Term 2

#### **Specialized sectional topics:**

- Inorganic Chemistry
- Organic Chemistry
- Physical Chemistry

Students would take nine selected courses. Both of MSci and BSc students would take literature projects.

Practical work (MSci)

Consist of Four courses i.e. Advanced Techniques in Organic, Inorganic, Computational and Physical Chemistry.

## Practical work (BSc)

Consist of two selected courses from organic, inorganic, computational or physical chemistry, and a research project

### 9. Chemistry with Language for Science

For Chemistry with language for science students would do a project in foreign languages concerning with the country where he/she stays..

- Language classes
- Scientific and Technical Translation for Chemistry

## Last Year

### MSci Courses (except for F104 with research overseas)

Students could take specialized subjects or courses overseas, and select from 100 courses from advance topics in physical chemistry, organics, inorganic, biochemistry and medicinal chemistry. Chemistry students with medicinal chemistry (CMC) mainly would select organic chemistry courses, biochemistry, and medicinal. Chemistry. CMC students with molecular Physics (CMP) should take Physical chemistry course.

The main course at the end of the year is an individual work project, chosen by the student and carried out under the supervision of the staff. Practical work is a research project. This includes writing a report and carry out oral presentation. CMC students would take medicinal biology and CMP students would carry out a research in molecular Physics.

### 10. MSci Chemistry with research overseas (F104)

Selected countries conducting research overseas: France, Germany, Italy, the Netherland, spain, Sweden and the USA.

### Humanity Project

This is a non-scientific project which is currently introduced in politics, economic, history, or the culture of the host country. The reports would be supervised and assessed by research center *for Co-Curriculum* (the Centre for Co-Curricular Studies).

### 11. Chemistry course and Communication technique:

Students could take 50 courses with the same standard with the last year of MSci Chemistry. Students would be assessed based on their ability on chemistry communication techniques. Research project in chemistry is similar to MSci students at year end. Reports are written in English and assessed by the Imperial College Business School.

### 12. Chemistry with Management courses

The last year of Chemistry with Management courses would be carried out in the Imperial College Business School.

#### Entry requirements

Students could enroll in Chemistry and Management should fulfill the following requirements:

#### A Level

<b>Grades</b>	AAA-ABB
<b>Subjects</b>	Chemistry subject or either one of science courses or math required.
<b>AS-Levels</b>	For students graduated from the UK require passed in a AS subject or equivalent.
<b>GCSE</b>	English course with a C grade plus, Math with a B grade. For students comes from the UK a C grade or equivalent in English course (except Old Greek, Biblical Hebrew or Latin) required.. UCL gives opportunity to fulfilling foreign language needed when enrolling.

#### IB Diploma

<b>Subjects</b>	16 – 18 points score in three higher subjects include chemistry and one of science subjects or math with score not less than 5.
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#### International qualifications

In addition to A level and BSc international, UCL considers various international qualifications to enroll in BSc program.

#### BSc Undergraduate Preparatory Certificates

UCL offers basic courses for one year intensive in order to prepare international students for various degree program in UCL. Certificate BSc preparatory (UPC) for the international students with a highly academically potential are provided for students who are willing to enroll into BSc program at UCL and the other top universities in the UK.

#### English Requirement.

If English is not your first language, you are required to meet English requirement. UCL provides various English language programs in the language centre and international education program.

#### DISCUSSIONS

Based on data above, it can be seen how important is chemistry students to study management course, even though it is taken as ancillary courses that might be needed before entering work markets. By studying management course, students are expected to

experiencing industrial training, where they could see and observe vary chemistry implemented in industry.

Chemists are responsible for managing chemical products and support the *Strategic Approach to International Chemicals Management* (SAICM) through chemistry management plans. This could be designed in order to meet the World Summit on Sustainable Development for sound management of chemicals.

Approach based on risk taking is developed through sound science management, assessment, and monitoring, and developed through varies apparatus in order to manage a potential risk caused by chemicals, and it is aimed to save human health and environment, and at the same time to supporting economic growth which is the core of continuous developments.

According to the *Canadian Environmental Protection Act, 1999* , *CEPA 1999*) which regulates the use of chemicals, that should be taken into consideration are::

*The Hazardous Products Act* – determine qualification standard hazard chemicals and the government regulates or prohibits consumer products and chemical products in the work place that risky to the consumers.

*The Pest Control Products Act* – warranty human health protection, safety, and environment by regulating products for pest control.

*The Food and Drugs Act* – regulates foods, drugs, natural health products, cosmetics and medical equipments for sale in the market place.

*The Transportation of Dangerous Goods Act* - promoting public safety during hazardous chemical transportation.

*The Fisheries Act* – forbids to discard toxic materials into waters and fishing environment.

The *Canada Labour Code* – regulates issues concerning with working safety and health, and vary regulation under this regulations ([https://www. Google .cz/search?q=](https://www.Google.cz/search?q=)).

From the Canadian Environmental Protection Act above, it can be seen that chemists are required to manage chemical products used, so they would not harmful to human being, animals and damage the environment.

## CONCLUSIONS

1. Chemistry course in Indonesia needs to be in line with industrial in order to meet stakeholder needs and chemistry graduates in accordance with the industrial development currently in Indonesia.



2. Chemistry and Management courses need to introduce into school of chemistry in Chemistry Department, Faculty of Basic Science, State University of Medan, in order to meet the need of market demands in the next future.
3. Chemistry students need to have experienced with industries, so they could see how chemistry is implemented in industrial context.

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