Nanyang Technological University
Division of Chemistry and Biological Chemistry

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| **Academic Year** | AY20/21 | **Semester** | 2 |
| **Course Coordinators** | Tan Howe Siang | | |
| **Course Code** | CM5004[1] | | |
| **Course Title** | From Alchemy to Chemistry (Team Project) | | |
| **Pre-requisites** | Nil | | |
| **Mutually Exclusive** | CM5003 | | |
| **No of AUs** | 3 | | |
| **Contact Hours** | Lecture: 39 hours (3 hours per week) | | |
| **Proposal Date** | 5 October 2020 | | |

**Course Aims**

On completing this course, you will understand and appreciate the course of historical events and intellectual progress that underlies the modern principles in Chemistry. You will be able to identify and describe the key persons and events that are important to the historical development of Chemistry.

**Intended Learning Outcomes (ILO)**

Upon successful completion of this course, you should be able to:

1. List and describe the main ideas in modern chemistry.
2. Describe the historical context and development of the ancient origin of alchemy (and chemistry). Identify the difference between alchemy and the science of chemistry.
3. Describe the early development of chemistry into a scientific discipline in the 17$^{th}$ and 18$^{th}$ centuries.
4. Explain the atomic hypothesis made in the early 19$^{th}$ century and describe the subsequent developments in inorganic chemistry.
5. Describe the development of organic chemistry and the introduction of the concept of molecular structure in the mid 19$^{th}$ century
6. Describe the historical development of the periodic table in the mid to late 19$^{th}$ century.
7. Describe and explain the concepts in physics applied to chemistry in the early 19$^{th}$ century. Describe the development of physical chemistry in the late 19$^{th}$ century.
8. Describe and explain the development of quantum mechanics and its application to the development of modern chemistry in the early 20$^{th}$ century.
9. Describe the development of chemistry and its applications to biology, material sciences and other fields since the early 20$^{th}$ century.

[1] Common Course with CM8003

**Course Content**

| | |
|---|---|
| 1 | Introduction to the Key Ideas in Modern Chemistry |
| 2 | From Alchemy since the Ancient Times to the Dawn of Chemistry (~1600CE) |
| 3 | From the Sceptical Chemists to the Chemical Revolution. How Chemistry becomes a science |
| 4 | The Atomic Theory and the Development of Inorganic Chemistry in the 19th Century |
| 5 | The Development of Organic Chemistry and the Concept of Molecular Structure in the 19th Century |
| 6 | The Development of the Periodic Table |
| 7 | The Development of Physical Chemistry and the applications of Physics to Chemistry in the 19th Century |
| 8 | Quantum Mechanics and the Rise of Modern Chemistry |
| 9 | Chemistry since the early 20th century |

**Assessment (includes both continuous and summative assessment)**

| Component | Course ILO Tested | Related Programme LO or Graduate Attributes | Weighting | Team/ Individual | Assessment rubrics |
|---|---|---|---|---|---|
| 1. Midterm Test | 1-6 | Competence, Civic-mindedness | 20% | Individual | Point-based marking (not rubrics based) |
| 2. Group Project | 1-9 | Creativity, communication and character, Competence, Civic-mindedness | 20% | Team | See Appendix |
| 3. Examination | 1-9 | Competence, Civic-mindedness | 60% | Individual | Point-based marking (not rubrics based) |
| Total | | | 100% | | |

**Formative feedback**

You will be given feedback in three ways:

1. By discussions post-lecture or during consultation hours
2. By the comments provided by the instructors after midterm tests and online quizzes
3. For the group project, discussions with instructor about progress will be made

**Learning and Teaching approach**

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|---|---|
| **Lectures** | Face-to-face lectures will be employed. The lectures may be replaced by online lecture videos. |
| **Videos** | Related documentary videos will be shown to enable you to have a more immersive understanding of certain conceptual that are discussed in the lecture |

**Reading and References**

Recommended reference book: Transforming Matter. A history of Chemistry from Alchemy to Buckyball (2001), by Trevor H. Levere, ISBN-13: 978-0801866098
Johns Hopkins University Press

**Course Policies and Student Responsibilities**

**(1) General**

You are expected to read the lecture materials prior to the lecture session in question. This will help you to learn much more efficiently as you will already have an impression on the topics to be covered.

**(2) Absenteeism**

If you miss a lecture, you are expected to make up for the lost learning activities. If you miss the mid-term test with approval, you will either be offered a make-up test or grading based upon the final exam score.

**Academic Integrity**

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

**Course Instructors**

| Instructor | Office Location | Phone | Email |
|---|---|---|---|
| Tan Howe Siang | SPMS-CBC-03-06 | 6316 2987 | howesiang@ntu.edu.sg |

**Planned Weekly Schedule**

| Week | Topic | Course ILO | Readings/Activities |
|---|---|---|---|
| 1 | Introduction to the Key Ideas in Modern Chemistry | 1 | Lecture |
| 1,2 | From Alchemy since Ancient Times to the Dawn of Chemistry (~1600CE) | 2 | Lecture |
| 3,4 | From the Sceptical Chemists to the Chemical Revolution. How Chemistry became a Science | 3 | Lecture |
| 4,5 | The Atomic Theory and the Development of Inorganic Chemistry in the 19$^{th}$ Century | 4 | Lecture |
| 5,6 | The Development of Organic Chemistry and the Concept of Molecular Structure in the 19$^{th}$ Century | 5 | Lecture |
| 6,7,8 | The Development of the Periodic Table | 6 | Lecture |
| 8,9 | The Development of Physical Chemistry and the applications of Physics to Chemistry in the 19$^{th}$ Century | 7 | Lecture, Midterms |
| 10,11 | Quantum Mechanics and the Rise of Modern Chemistry | 8 | Lecture |
| 12 | Chemistry since the early 20$^{th}$ century | 9 | Lecture |
| 13 | Recapitulation and other topics | 1-9 | Lecture |

**Appendix: Assessment Criteria for Group Project Component**

**Group Project Work**

You will carry out the project work in groups of 4 to 5 with a mixture of students from different degree programs (to be decided and/or specified by the instructor). Your group will produce a set of Powerpoint Slides and Video on a topic in History of Chemistry as determined or agreed by the instructor. In practice, you would receive the same marks as your team. However, your score may vary if there is evidence that you did not contribute to your team.

| **EVALUATION RUBRIC FOR POWERPOINT SLIDES & VIDEO** | | | | |
|---|---|---|---|---|
| | **Unsatisfactory** | **Satisfactory** | **Good** | **Excellent** |
| **Content** | Not related to topic, missing or incomplete | Contains several inaccuracies or incorrect information | Mostly accurate, and demonstrates a surface understanding of topic | Accurate, informative and thorough explanation of topic |
| **Creativity** | No attempt was made to make presentation | Majority of the information is cut and paste and shows little or no originality | Concept is original and shows clear effort of creativity in design | Concept is original, engaging and shows clear effort of creativity in design and presentation |
| **Peer Evaluation by the rest of the class** | Failed in being engaging and informative | Partially engaging and informative | Engaging and informative | Extremely engaging and informative |
| **Preparation and Collaboration** | No evidence of group collaboration or preparation | Little evidence of group collaboration and much over-dominance. Preparation appears to be minimal. | Some evidence of group collaboration, but several members contributed minimally. Some preparation is evident. | Clear attempt at group collaboration, but still some overdominance. Preparation is evident. |

**CBC Programme Learning Outcome**

The Division of Chemistry and Biological Chemistry (CBC) offers an undergraduate degree major in Chemistry that satisfies the American Chemical Society (ACS) curricular guidelines and equips students with knowledge relevant to the industry. Graduates of the Division of Chemistry and Biological Chemistry should have the following key attributes:

**1. Competence**

Graduates should be well-versed in the foundational and advanced concepts of chemical science, be able to evaluate chemistry-related information critically and independently, and be able to use complex reasoning to solve emergent chemical problems.

**2. Creativity**

Graduates should be able to synthesize and integrate multiple ideas across the curriculum, and propose innovative solutions to emergent chemistry-related problems based on their training in chemistry.

**3. Communication**

Graduates should be able to demonstrate clarity of thought, independent thinking, and sound scientific analysis and reasoning through written and oral reports to audiences with varying technical backgrounds. They should also be able to effectively engage other professional chemists in collaborative endeavours.

**4. Character**

Graduates should be able to act in responsible ways and uphold the high ethical standards that the society expects of professional chemists.

**5. Civic-mindedness**

Graduates should be aware of the impact of chemistry on society, and how chemistry can be applied to benefit mankind. They should also be aware of and uphold the best chemical safety practices.