Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Loh Zhi Heng
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Course Title	CHEMISTRY & BIOLOGICAL CHEMISTRY LABORATORY 2
Course Code	CM2062
Academic Units	3
Contact Hours	54
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CY1101 or CM1001
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This laboratory course aims to complement and supplement the lecture courses of CM1001, CM2011, and CM2041 by providing experimental demonstrations and verifications of the points discussed therein. This course allows you to hone your practical experimental skills in analytical and physical chemistry that are essential for chemists working in industry and academia. At the same time, taking this course will allow you improve your problem solving ability and your skills in scientific communication, both oral and written. Your experience of the experimental techniques used in analytical and physical chemistry will be enhanced, and you will be trained in the safe handling of chemicals and instruments, and in the assessment of risks associated with experimental procedures

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Work independently and, where required, in collaboration with other students to safely perform the experiments described in the laboratory manual.
ILO 2	Follow detailed instructions in the laboratory manual to obtain desired experimental results.
ILO 3	Perform quantitative chemical analysis by employing techniques in electrochemistry, calorimetry, chromatography, and spectroscopy.
ILO 4	Operate scientific equipment in the laboratory and describe their operating principles.
ILO 5	Analyze the experimental data by using various theoretical models.
ILO 6	Explain the scientific principles underlying each experiment.
ILO 7	Read scientific literature to gain a deeper understanding of your experimental results.
ILO 8	Work independently to prepare a detailed written report of your experimental findings.
ILO 9	Keep a detailed laboratory notebook, recording your experimental findings in a form that is understandable by a third party.
ILO 10	Perform computational chemistry simulations to determine the electronic and vibrational properties of molecules.
ILO 11	Assess the potential risks of an experimental procedure before the procedure is carried out.
ILO 12	Review the experimental procedures after the experiments have been completed to identify additional potential risks and propose how they can be mitigated.

Course Content

1: Computational Chemistry: Introduction to Gaussian

2: Bomb Calorimetry

3: Conductivity and Electrochemical Cells

4: Absorption Spectroscopy of Conjugated Dyes

5: Fluoride Ion-Selective Electrode (ISE)

6: Spectrophotometric Determination of the Dissociation Constant of an Acid-Base Indicator

7: Halide (Cl–) Quenching of Quinine Sulfate Fluorescence

8: Determining the CMC of a Surfactant by Contact Angle Measurements

9: High Performance Liquid Chromatography: Separation and Quantification of Caffeine in Cola Drinks

Reading and References (if applicable)

Reading references are provided in the laboratory manual. You will also be required to use the on-line databases of the library to find new relevant reference materials in the scientific literature.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Computational Chemistry: Introduction to Gaussian	1, 2, 5 – 10		In-person	Computer simulation; proforma provided
2	Bomb Calorimetry	1 – 12		In-person	Laboratory experiment; proforma provided
3	Conductivity and Electrochemical Cells	1 – 12		In-person	Laboratory experiment; proforma provided
4	Absorption Spectroscopy of Conjugated Dyes	1 – 12		In-person	Laboratory experiment; proforma provided
5	Fluoride Ion-Selective Electrode (ISE)	1 – 12		In-person	Laboratory experiment; proforma provided
6	Spectrophotometric Determination of the Dissociation Constant of an Acid-Base Indicator	1 – 12		In-person	Laboratory experiment; written report required
7	Halide (Cl^-) Quenching of Quinine Sulfate Fluorescence	1 – 12		In-person	Laboratory experiment; written report required
8	Determining the CMC of a Surfactant by Contact Angle Measurements	1 – 12		In-person	Laboratory experiment; written report required

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	High Performance Liquid Chromatography: Separation and Quantification of Caffeine in Cola Drinks	1 – 12		In-person	Laboratory experiment; written report required

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Pre-lab self-study	Before reporting to lab, you are expected to read through the relevant section of the lab manual, watch the recorded lab briefing, prepare the lab notebook entries, complete the pre-lab exercises, and perform the pre-lab risk assessment. By familiarizing yourself with the experiment, including safety precautions to be taken, before setting foot in the lab, you will be work more efficiently in the lab and have a better appreciation for the various experimental procedures.
Performing experiments in the lab, analyzing data, and preparing lab reports or proformas	The majority of the course is conducted in the teaching laboratory where you will receive hands-on training for the various pieces of equipment. The experiments will be performed in groups, although you are expected to gain full knowledge of all parts of the experimental procedures. The data analysis and subsequent proformas or reports are expected to be done individually so that you are familiar with all the theoretical aspects of the experiments.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Others(Lab Performance)	1 – 12	Competence, Creativity, Communication and Character	30	Students will be assessed based on their adherence to safety regulations; understanding of the scientific principles of the experiment and the operating principles of the instruments; experimental technique; teamwork, time management and communication skills; organization of lab workspace and lab notebook.	Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Report/Case study(Lab Proformas and Reports)	5 - 8	Competence, Creativity, and Communication	30	Students will be assessed based on their ability to present, analyze, discuss, and put forth conclusions based on experimental data.	Individual	Analytic	Relational

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
3	Summative Assessment (EXAM): Final exam()	3 - 8	Competence and Creativity	40	Students will be assessed on their understanding of the scientific and operating principles underlying the CM2062 experiments, as well as their scientific reading comprehension, critical thinking, and written communication skills.	Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

Formative Feedback

You will be given feedback in three ways: 1. Through teaching assistants (TAs), who will be present for each individual experiment. 2. Through the graded lab reports and lab proformas. 3. Through consultation with the faculty member who designed the lab experiment.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Collaboration	Intermediate
Communication	Intermediate
Sense Making	Intermediate
Information Literacy	Intermediate
Critical Thinking	Intermediate

Course Policy

Policy (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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

The instructors and Chief TA of CM2062 take a very serious stance on laboratory safety, punctuality and academic integrity.

Laboratory safety and punctuality

1. Students who flout safety rules spelt out in the CM2062 laboratory manual will be expelled from the laboratory.

2. The lab sessions begin at 9:30 a.m. Students are to report to the lab 5 – 10 minutes before 9:30 a.m. A significant percentage of marks (up to 50%) will be deducted for students who are late for any of the laboratory sessions without a valid reason. Students who arrive 20 minutes after the start of the lab session will not be allowed to enter the lab and will receive zero marks for the experiment.

3. Students are not allowed to leave the laboratory amidst an experiment without permission from the TA. Students found missing from the lab without approval will be taken to have left for the day and will be given zero marks for that experiment.

4. Students who have completed an experiment are expected to turn in the carbon copies of their notebook pages to their TA, sign out, and exit the lab immediately.

5. Students are expected to submit their lab reports/proformas on time. This is usually one week after you have completed the lab session, unless you have been granted permission to delay submission by the course instructor. Lab reports/proformas submitted after the due date will not be accepted and students will receive zero marks for that experiment. If you have a valid reason for missing a lab, you must submit the previous week's report to the lab before 10 a.m. on the next working day upon expiration of the MC.

Academic integrity and generative AI usage

1. Plagiarism: While students are assigned to work in groups in the lab, they are expected to analyze the data and to write up their lab reports independently. Data analysis includes tabulating data, graphing data, and performing calculations to obtain various physical parameters. Each student is responsible for preparing his/her own set of tables and graphs to be used in the report. When preparing the lab report, students should not use illustrations from

the lab manual or from other sources, including the internet, without proper attribution. Moreover, even with proper citation, students should not lift texts and use them in their lab reports without paraphrasing. Paraphrasing is not just substituting one or two words in a sentence; instead, you should take the idea, understand it, and then re-write it in your own words. Please note that plagiarism includes duplicating, either in part or in full, the lab report of either a lab mate or a senior. A student who allows his/her lab report to be plagiarized will also face disciplinary action.

2. Data manipulation: Students are not to fabricate data or alter the collected data in any way. In some instances, a student might realize during data analysis that a particular data point deviates significantly from the best-fit line. In such cases, instead of removing the data point from the graph or changing the value of the data point, the student should provide an explanatory note as to what might have happened in lab during the data acquisition to have caused the significant deviation. If the student chooses to omit any data points from the analysis, e.g., in the generation of the best-fit line, the student should state this explicitly in the report, along with a justification of the omission.

3. Use of Generative AI (GAI): GAI is becoming a tool in the workplace and it is important that you understand how it can be effectively used. While the CM2062 instructors do not explicitly prohibit the use of AI in preparing your lab reports, you are strongly discouraged from using AI to generate ideas and to prepare the first draft. Doing so will not only prevent you from mastering the course material, it will also come at the expense of the development of your cognitive and written communication skills — skills that will serve you beyond CM2062. Therefore, it is important that you engage with the material yourself, analyze your data, and form your own conclusions. It is also important that you prepare the first draft yourself because that is when critical thinking and writing skills are developed. Upon completing the first draft, however, you are permitted to use GAI to refine the report. You must take full responsibility for the final version, and each submission must be accompanied by a GAI declaration form.

4. The instructors have zero-tolerance for academic dishonesty. Students who commit academic misconduct will face disciplinary action.

Policy (Absenteeism)

If you are unable to attend any of the assigned lab sessions you must provide the original supporting document, e.g., medical certificate from a medical doctor, order for court appearance, to the CCEB UG Office within 7 days of the missed lab session. In addition, you must email or present to the Chief TA a copy of the supporting document within 2 days after your excuse has expired.

If you need to obtain a Leave of Absence for any of the labs, please file a formal application through the CCEB UG Office. Only official approvals from the CCEB UG Office will be accepted. Failure to do so will result in a zero grade for the lab from which the student is absent.

You must complete at least 8 out of the 9 experiments in order to be allowed to sit for the final exam. There will not be any make-up laboratory experiments; students who miss more than one experiment will receive a “LOA” grade.

Policy (Others, if applicable)

Diversity and Inclusion Policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science and engineering.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences. That honours your identities; including ethnicity, gender, socioeconomic status, sexual

orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel your performance in the course is being impacted by your experiences outside of class;
- If something was said in the course (by anyone, including instructor/supervisor) that made you uncomfortable.

Please e-mail to your Associate Chair (Students & Continuing Education) at ac-cceb-stud@ntu.edu.sg about how we can help facilitate your learning experience.

As a participant in course discussions you should also strive to honour the diversity of your classmates. You can do this by; using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the course are expected to strictly adhere to the student code of conduct (https://www.ntu.edu.sg/life-at-ntu/student-life/student-conduct) . If you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

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