

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

Course Overview

Expected Implementation in Academic Year (New format)	AY2022-2023
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Anuvab Das
Course Author Email	anuvab.das@ntu.edu.sg
Course Title	Chemistry & Biological Chemistry Laboratory 1
Course Code	CM2061
Academic Units	3
Contact Hours	117
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	(CM1021 and CM1031) or CM9001/CM5000, or CY1101 or (CM1001 and CM1002) or by permission
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

On completing this course, you will be able to carry out laboratory operations in synthetic chemistry associated with the synthesis of organic and inorganic compounds. These may include reactions requiring heating, inert atmosphere, use of bio-reagents and handling reactive intermediates. You will be able to work in a safe and responsible fashion, showing consideration for others in the laboratory. You will be able to evaluate the risks inherent in the procedures and formulate appropriate precautions. You will be able to purify the products of the reactions using techniques that may include recrystallisation, column chromatography and distillation under reduced pressure. You will be able to obtain and interpret characterisation data that may include ^1H NMR spectroscopy, infra-red spectroscopy, polarimetry and magnetic susceptibility measurement.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	evaluate risks in a synthetic procedure and devise appropriate precautions
ILO 2	carry out the procedures contained in the course in order to synthesise both organic and inorganic compounds and understand the circumstances in which their use is appropriate
ILO 3	carry out the purification procedures contained in the course and understand the circumstances in which their use is appropriate
ILO 4	explain the reasons behind the use of the procedures and be able to identify circumstances when they are used improperly
ILO 5	characterise synthesised compounds by the methods contained in the course
ILO 6	suggest the appropriate technique or techniques to characterise a synthetic compound
ILO 7	interpret the data arising from the characterisation techniques contained in the course

Course Content

The synthesis, qualitative and quantitative analysis of organic and inorganic compounds. Techniques for the synthesis of both organic and inorganic compounds. Methods of purification of organic and inorganic reaction products, preparation. Systematic characterisation of synthetic compounds by spectroscopic and other methods, and interpretation of the data obtained. Evaluation of laboratory risks. The content builds upon techniques and concepts from the year 1 courses.

The course will be a combination of conventional in person laboratory experiments and e-labs. In an e-lab, students will follow a LAMS sequence showing videos of different parts of the experiment as well as downloadable data for analysis, interspersed with MCQs for formative assessment.

Reading and References (if applicable)

Reading references are provided in the laboratory manual.

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	online pre-lab activities	1	Online	video, reading and quizzes	
2	Student will be assigned to do ONE only: 1A Synthesis of Paracetamol 1B Synthesis of Phenyl toluene-p-sulfonate 1C The Aldol Reaction: Synthesis of Dibenzalacetone 1D Synthesis of $\text{Py}_2\text{Zn}(\text{NCO})_2$ 1E Synthesis of N-p-Toluenesulfonylpyrrole 1F The Aldol Reaction: Tetraphenylcyclopentadienone	1-7	In-person	online interactive content, laboratory experiments, report writing	
3	Metal Chelate	1-7	Online	online interactive content, laboratory experiments, report writing	
4	THP Ether	1-7	Online	online interactive content, laboratory experiments, report writing	
5	Reductive Amination	1-7	Online	online interactive content, laboratory experiments, report writing	
6	Student will be assigned to do ONE only: 5A: Nitration of Methyl Benzoate 5B: Dinitration of Veratrole 5C: Nitration of Methylenedioxybenzene 5D: Synthesis of o-Iodobenzoic acid 5E: Synthesis of 2-Trifluoroacetylpyrrole	1-7	In-person	online interactive content, laboratory experiments, report writing	

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
7	Reduction of a β -Ketoester ester	1-7	In-person	online interactive content, laboratory experiments, report writing	
8	A Friedel-Crafts Reaction and Column Chromatography	1-7	In-person	online interactive content, laboratory experiments, report writing	
9	Silicon-Oxygen Compounds and Siloxane Polymers	1-7	In-person	online interactive content, laboratory experiments, report writing	
10	Synthesis of Benzoic Acid	1-7	In-person	online interactive content, laboratory experiments, report writing	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Laboratory experience supported by online methods	This is a practical course for you to gain hands on experience. You will carry out experiments yourself to gain experience in handling equipment, chemicals and instruments in a safe, efficient and capable way. Your learning will be supported by pre-lab content, including videos, so that you will be prepared before starting practical work.

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(Online quizzes)	2,3,4	Competence	5		Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Assignment(Laboratory reports during the semester)	1,2,3,4,5,7	competence, communication, civic mindedness	30		Individual	Analytic	Relational
3	Continuous Assessment (CA): Others(E-labs)	1,4,6,7	competence, creativity	15		Individual	Analytic	Relational
4	Summative Assessment (EXAM): Final exam(Final Examination)	1,2,3,4,6,7	competence, creativity	50		Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

Formative Feedback

You will be given feedback in three ways:

1. Through marking of the lab reports.
2. By the teaching assistants and faculty members during the laboratory session.
3. In the LAMS activities as part of the e-labs

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Decision Making	Intermediate
Learning Agility	Intermediate
Problem Solving	Intermediate
Self-Management	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)

You are expected to complete all online activities in good time. You are expected to work safely and efficiently in the laboratory with consideration for other students and the various university staff who support your laboratory work. This includes leaving a clean working space at the end of the day. You will submit well prepared work in good time. In the lab, you will plan the use of your time carefully so that you complete all laboratory operations in good time.

Policy (Absenteeism)

You must attend and complete all 6 in-lab experiments in order to be allowed to sit for the final exam. Students who miss any experiment will receive a "LOA" grade for the whole course.

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 the Teaching Lab staff a copy of the supporting document within 2 days after your excuse has expired.

If you need to obtain a Leave of Absence (LOA) 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 mark for the lab from which the student is absent.

Make-up laboratory experiments will only be arranged for students with an approved LOA from the CCEB UG office. Students who are absent without an approved LOA will not be allowed to do any make-up session and will receive a zero mark for that missed lab.

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 (Undergraduate) at ac-cceb-ug@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.

Technical Skills To Be Developed

All skills to be developed for this course:

Synthetic Chemistry Lab skills, Analytical Chemistry Lab skills, Laboratory Safety skills, Data processing and analysis skills, Time-management skills

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