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	Lee Hiang Kwee, Zhang Zhengyang
Course Author Email	hiangkwee@ntu.edu.sg; zhang.zy@ntu.edu.sg
Course Title	MATERIALS CHEMISTRY
Course Code	CM4061
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CM1021 or CM9001 or CM5000 or CM1001 or CY1101 or (BS1012 and BS1022) or by permission
Co-requisites	
Pre-requisite to	
Mutually exclusive to	CM9021
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to provide a broad introduction to contemporary topics in materials science, with an emphasis on relating materials chemistry to their unique properties and real-world applications. We will discuss fundamental chemistry governing the properties of various materials, and gain insights on current material-based technologies and research. Upon completing this course, you will be able to appreciate the importance of materials in our everyday lives and explain their working principles. This course will provide students an opportunity to gain expertise in both chemistry and materials sciences, thereby supporting you for future career in relevant industries (e.g. semiconductors, energy and biomedical) and/or materials research.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Introduction and fundamental principles of materials chemistry 1. Describe the differences between different classes of materials 2. Explain the relationships between molecular structure and physical/chemical properties 3. Describe the lattice and unit cell of different crystal structures 4. Explain the effects of defects on material properties
ILO 2	Characterization methods 5. Identify appropriate characterization techniques for different material properties 6. Describe the key components of various characterization techniques 7. Explain the working principles of characterization tools 8. Rationalize the data obtained from materials characterizations
ILO 3	Semiconductors 9. Describe and differentiate the band structures of semiconductor from metal and insulator 10. Explain the effect of doping on band structures 11. Explain the working principles of semiconductors 12. Determine the figure of merits for semiconductors 13. Explain the role of semiconductors in photo-catalysis and solar energy harvesting
ILO 4	Energy storage materials 14. Describe key components and working principles of a battery and a capacitor 15. Quantify battery thermodynamics to select potential anodic/cathodic materials 16. Describe the differences between charging/discharging processes 17. Determine the figure of merits for different energy storage materials 18. Compare and contrast a battery and a capacitor
ILO 5	Optical materials 19. Explain the fundamental principles of optical materials 20. Identify and describe different types of optical materials 21. Identify and discuss main applications of optical materials 22. Design optical materials
ILO 6	Magnetic materials 23. Explain the fundamental principles of magnetic materials 24. Identify and describe different types of magnetic materials 25. Identify and discuss main applications of magnetic materials 26. Design magnetic materials
ILO 7	Porous materials 27. Explain the fundamental principles of porous materials 28. Identify and describe different types of porous materials 29. Identify and discuss main applications of porous materials 30. Design porous materials
ILO 8	Biomedical materials 31. Explain the fundamental principles of biomedical materials 32. Identify and describe different types of biomedical materials 33. Identify and discuss main applications of biomedical materials 34. Design biomedical materials

Course Content

1. Chapter 1 – Introduction and fundamental principles of materials chemistry
2. Chapter 2 – Characterization methods
3. Chapter 3 – Semiconductors
4. Chapter 4 – Energy storage materials
5. Chapter 5 – Optical materials
6. Chapter 6 – Magnetic materials
7. Chapter 7 – Porous materials
8. Chapter 8 – Biomedical materials

Reading and References (if applicable)

1. Introduction to Materials Chemistry, by Harry R. Allcock, John Wiley & Sons, Inc., 2019, ISBN: 978-1-119-34725-5.
2. Fundamentals of Materials Science and Engineering, by William D. Callister, John Wiley & Sons, Inc., 2001, ISBN-10: 047139551X.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction and fundamental principles of materials chemistry	1 – 4		In-person	Lecture, Assignment
2	Characterization methods	5 – 8		In-person	Lecture, Assignmen
3	Semiconductors	9 – 13		In-person	Lecture
4	Semiconductors	9 – 13		In-person	Lecture, Assignment
5	Energy storage devices	14 – 18		In-person	Lecture
6	Energy storage devices	14 – 18		In-person	Lecture, Assignment
7	Midterm I	1 – 18		In-person	Assessment
8	Optical materials	19-22		In-person	Lecture, Assignment
9	Magnetic materials	23-26		In-person	Lecture, Assignment
10	Porous materials	27-30		In-person	Lecture, Assignment
11	Biomedical materials	31-34		In-person	Lecture, Assignment
12	Midterm II	19-34		In-person	Assessment
13	Course review	19-34		In-person	Lecture

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Face to face or online lectures will be employed for ILO 1 – 34. This is to allow interactions between you and the instructors. You could also immediately clarify your doubt/question.
Assignments	Allow instructors to challenge you during lecture and to achieve instant feedback. It also allows you to review the knowledge point right after the delivery and to master the knowledge in-depth.
Videos	Supplementary videos and animations may be used as alternative learning materials to reinforce your understanding on the course contents.

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): Assignment()	1-18	Competence, Creativity, Civic-mindedness	10	Assignments for various chapters	Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Test/Quiz(Mid-term Test 1)	1-18	Competence	10		Individual	Analytic	Relational
3	Continuous Assessment (CA): Assignment(Literature Review)	19 – 34	Competence, Creativity, Civic-mindedness	10		Individual	Analytic	Relational
4	Continuous Assessment (CA): Test/Quiz(Mid-term Test 2)	19 – 34	Competence, Creativity, Civic-mindedness	10		Individual	Analytic	Relational
5	Continuous Assessment (CA): Class Participation()	1 - 34	Civicmindedness	5		Individual	Analytic	Multistructural
6	Summative Assessment (EXAM): Final exam()	1 – 34	Competence, Creativity, Civic-mindedness	55		Individual	Analytic	Relational

Description of Assessment Components (if applicable)

Formative Feedback

You will be given feedback in five ways:

1. By response to postings on the course discussion board.
2. During online lectures.
3. Through face-to-face discussion during lecture.
4. Through the marking of assignments and mid-term tests.
5. Examiner report will be provided to the students after final exam.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Curiosity	Basic
Problem Solving	Intermediate
Sense Making	Basic
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 assignments in good time.

Policy (Absenteeism)

If you miss a lecture, you are expected to make up for the lost learning activities. If you are sick and unable to attend your class, you have to:

1. send an email to the instructor regarding the absence
2. submit the original Medical Certificate‖ to the administrator. (‖ the medical certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.)

If you miss the mid-term test with approval, you will be provided with make-up test.

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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Last Updated By: Natasha Bhatia (Dr)