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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Lee Hiang Kwee, Rei Kinjo
Course Author Email	hiangkwee@ntu.edu.sg; rkinjo@ntu.edu.sg
Course Title	Inorganic and Bioinorganic Chemistry
Course Code	CM2021
Academic Units	3
Contact Hours	44
Research Experience Components	Not Applicable

Course Requisites (if applicable)

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

Course Aims

This course builds upon the ideas introduced in General Chemistry and aims to provide the fundamental ideas of Inorganic Chemistry, in particular bonding theories, main-group element compounds and transition metal coordination complexes. You will learn different bonding theories to explain the structures and hence reactivity of main-group element compounds and transition metal coordination complexes.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Simple Bonding Theory Describe and discuss the “Chemical and Physical Bonding” including, covalent bond, ionic bond, Van der Waals force, hydrogen bonding, dipole-dipole interaction, dative bond, and metallic bond. Explain bonding and electronic structure found in heavier elements-containing molecules. Discuss the relationship between bonding and physical property such as melting point, boiling point, and conductivity of molecules/ions.
ILO 2	Simple Bonding Theory Describe and discuss the “Chemical and Physical Bonding” including, covalent bond, ionic bond, Van der Waals force, hydrogen bonding, dipole-dipole interaction, dative bond, and metallic bond. Explain bonding and electronic structure found in heavier elements-containing molecules. Discuss the relationship between bonding and physical property such as melting point, boiling point, and conductivity of molecules/ions.
ILO 3	Chemistry of Main-Group Elements Describe the general property of main group elements. Explain the synthesis, reactivity, and general application of typical main group molecules. Interpret and explain the concepts of (i) isotope effect, (ii) hard and soft acids and bases (HSAB) theory, (iii) diagonal relationships, (iv) inert pair effect, (iv) substituent (alpha- and beta)-effects, (v) average oxidation state, (vi) Gauche effect. Describe the name reactions related to the synthesis of main group molecules. Explain the important industrial processes and product schemes of typical main group compounds.

ILO 4	Chemistry of Transition Metal Coordination Complexes Interpret molecular formula, nomenclature and structure of transition metal coordination complexes. Determine valence electrons and compute the oxidation state of a metal center in transition metal coordination complexes. Contrast the ligand combinations and oxidation states of a given metal atom. Contrast common oxidation states within transition metal elements. Interpret isomerism in transition metal coordination complexes and the corresponding reactivity. Compare thermodynamic and kinetic stability of metal-ligand bonds. Determine and interpret bonding in transition metal coordination complexes. Interpret UV-Vis spectroscopic signals and magnetic properties of transition metal coordination complexes Explain reaction mechanisms of transition metal complexes.

Course Content

1. Simple Bonding Theories
2. Molecular Orbitals
3. Chemistry of Main-Group Elements
4. Chemistry of Transition Metal Coordination Complexes

Reading and References (if applicable)

Textbook: Inorganic Chemistry, 5/e by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr [ISBN 10: 1-292-02075-X; ISBN 13: 978-1-292-02075-4]

Reference book: Inorganic Chemistry, 4th Edition by Catherine Housecroft and Alan G. Sharpe [ISBN: 978-0-273-74275-3]

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Simple Bonding Theory	1	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures		
2	Molecular Orbitals Theory	2	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
3	Chemistry of Main-Group Elements	3	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
4	Chemistry Of Main-Group Elements	3	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
5	Chemistry of Main-Group Elements	3	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
6	Chemistry of Main-Group Elements	3	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
7	Nomenclature and Structure of Transition Metal Coordination Complexes	4a-4e	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
8	Nomenclature and Structure of Transition Metal Coordination Complexes	4a-4e	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Bonding Theories of Transition Metal Coordination Complexes	4f-4g	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
10	Bonding Theories of Transition Metal Coordination Complexes	4f-4g	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
11	UV-Vis Spectroscopy and Magnetic Properties of Transition Metal Coordination Complexes	4h	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
12	UV-Vis Spectroscopy and Magnetic Properties of Transition Metal Coordination Complexes	4h	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		
13	Reactions and Mechanisms of Transition Metal Complexes	4g-4h	(1) Reading lecture notes and textbook (2) Answering tutorial questions based on scientific literatures.		

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture with incomplete notes and hand-written examples	To encourage you to remain engaged in lectures by taking notes and working on in-class examples. The engagement facilitates you to understand the chemistry delivered in lectures. You are also less likely to sit back, relax, and watch a performance while understanding nothing.
Video clips relevant to the class	To help you visualize chemistry concepts and enhancing your understanding.
Lectures with in-class practice examples	To help you verify your understanding of lectures in real time as well as your ability to apply precise and correct chemistry concepts in problem-solving questions. Through practice, you learn to what extent you need to master and apply a particular knowledge point. To show you common mistake(s) you can make and difficult points to master.
Clickers	To provide instant feedback in lectures in real time about the level of understanding and the level of difficulty of the concept. To give you the opportunity to measure and compare your learning in class To highlight common mistakes and tricky pointed related to lectures
Tutorials conducted by teaching assistants	To let you familiarize with types of questions related to learning points in lectures, and to what extent you need to master and apply To help you to apply precise and correct chemistry concepts in problem-solving questions To develop soft skills such as critical thinking, team work from tackling difficult questions and presentation skills from providing answers to peers

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Midterm 1)	1-3	Competence, Creativity	20	Individual	Analytic	Not Applicable
2	Continuous Assessment (CA): Test/Quiz(Midterm 2)	4	Competence, Creativity	20	Individual	Analytic	Not Applicable
3	Continuous Assessment (CA): Class Participation()	1-4	Competence, Creativity	5	Individual	Analytic	Not Applicable
4	Summative Assessment (EXAM): Final exam()	1-4	Competence and creativity	55	Individual	Analytic	Not Applicable

Description of Assessment Components (if applicable)

Formative Feedback

Along the way, you will receive formative feedback through verbal or written sharing on common mistakes made in tests, quizzes and assignments, so you can learn from them.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Communication	Basic
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 assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions you have missed. You are expected to participate in all seminar discussions and activities.

Policy (Absenteeism)

Attendance of classes is strongly encouraged for discussion with lecturers as well as for participation in clicker and in-class practice.

For those absent, you must catch up each week and follow the pack of lectures and tutorials each week.

When you miss a lecture, you are expected to make up for the lost learning activities. If you miss any mid-term tests due to valid reasons, the overall grading will be based on other tests that you have attended or the final exam score.

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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