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	Professor Jason Xu Zhichuan / Associate Professor Xue Can
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Course Title	Properties & Applications of Nanomaterials
Course Code	MS6013
Academic Units	1
Contact Hours	13
Research Experience Components	

Course Requisites (if applicable)

Pre-requisites	MS6012 Foundations of Nanomaterials
Co-requisites	
Pre-requisite to	
Mutually exclusive to	MS7410 Nanomaterials
Replacement course to	
Remarks (if any)	Coursework students who have previously completed MS7410 Nanomaterials will not be allowed to read MS6013 Properties & Applications of Nanomaterials.

Course Aims

The aim of this course is to provide you the advanced knowledge of nanomaterials in terms of properties and applications. In Foundations of Nanomaterials, you already learn the size effect of nanomaterials, state-of-the-art synthetic methods of nanomaterials and the key factors to stabilize the nanomaterials. In this course, you will learn the fascinating properties of these nanomaterials including optical properties, magnetic properties and catalytic properties. At the end of this course, you will be able to explain the interesting properties of nanomaterials, recommend and propose appropriate nanomaterials solutions given a problem. This course will also introduce several important applications of nanomaterials through case studies to illustrate how nanomaterials impact the industry and human life. This course will prepare you for exploration in materials development and/or to continue higher postgraduate studies.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Understand the optical, magnetic and catalytic properties of nanomaterials
ILO 2	Given a problem, propose appropriate nanomaterials solutions

Course Content

This course is organized into three modules:

- **Module 1**: Optical properties- surface plasmon resonance, fluorescence, charge/energy transfer
- **Module 2**: Magnetic properties – size matters, synthesis methods, surface properties etc.
- **Module 3**: Catalytic properties – automobile exhaust gas treatment and fuel cell catalysts industry case studies

Reading and References (if applicable)

1. Nanomaterials: An Introduction to Synthesis, Properties and Applications by Dieter Vollath, WILEY, 2008.
2. The Physics and Chemistry of Nanosolids by Frank J. Owens and Charles P. Poole Jr., Wiley, 2007.
3. Optical Properties and Spectroscopy of Nanomaterials by Jin Zhong Zhang, World Scientific, 2009
4. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek, Elsevier, 2009
5. Introduction to Nanoscience by Cabor L. Hornyak, H.F Tibbais, Joydeep Dutta, Anil Rao, CRC Press, 2008

Note: The above listing comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they become available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Localized Surface Plasmon Resonance (SPR); Surface Plasmon Resonance - induced enhancement	1, 2	Optical Properties and Spectroscopy of Nanomaterials by Jin Zhong Zhang, World Scientific, 2009	Online	Pre-recorded lectures (2 hr)
2	Quantum Dot Emission; Fluorescence of Metal Clusters	1	Optical Properties and Spectroscopy of Nanomaterials by Jin Zhong Zhang, World Scientific, 2009	Online	Pre-recorded lectures (2 hr)
3	Charge/Energy Transfer; Magnetic Nanoparticle: Size Matters	1, 2	Optical Properties and Spectroscopy of Nanomaterials by Jin Zhong Zhang, World Scientific, 2009 Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek, Elsevier, 2009	Online	Pre-recorded lectures (2 hr)
4	Synthetic Methods of Magnetic Nanoparticles; Surface Properties of Magnetic Nanoparticles	1	Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek, Elsevier, 2009	Online	Pre-recorded lectures (2 hr)
5	Applications of Magnetic Nanoparticles; Catalytic Nanoparticles	1, 2	Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek, Elsevier, 2009	Online	Pre-recorded lectures (2 hr)
6	Case Study I: Automobile Exhaust Gas Treatment; Case Study II: Fuel Cell Catalysts	2	N/A	Online	Pre-recorded lectures (2 hr)

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
7	Continual Assessment 1 (CA1): Final Quiz	1, 2	N/A	Online	Continual Assessment 1 (CA1): Final Quiz (1 hr)
8	Submission of Continual Assessment 2 (CA2): Essay	1, 2	N/A	Online	Submission of Continual Assessment 2 (CA2): Essay

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Online lectures	On-line lectures hosted by the Adaptive Teaching and Learning Applications System (ATLAS) are coupled with dynamic learning trees and closed captioning will accelerate learning and allow self-checking of understanding at your own pace.
Online assessments	One continuous assessment will be conducted online through the semester.

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): Test/Quiz(Continual Assessment 1 (CA1): Individual MCQ Quiz)	1,2		50		Individual	Holistic	Relational
2	Continuous Assessment (CA): Report/Case study(Continual Assessment 2 (CA2): Individual Essay)	1,2		50		Individual	Holistic	Relational

Description of Assessment Components (if applicable)

Continual Assessment 1 (CA1): Individual MCQ Quiz
MCQ comprises 10 questions. Duration of the assessment is 1 hour.

Continual Assessment 2 (CA2): Individual Essay
1-2 pages write-up

Formative Feedback

The CAs will measure your ability to understand the properties and applications of nanomaterials. The students will receive written feedback about the learning progress in the course and the results of assessments.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Creative Thinking	Advanced
Curiosity	Advanced
Problem Solving	Advanced
Design Thinking	Advanced
Systems Thinking	Advanced

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 readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

Online class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for online class activities.

Policy (Others, if applicable)

Students may use Generative Artificial Intelligence (GAI) tools for the essay assignment, but the usage shall be restricted to refining syntax and grammar only. Students will be required to submit a declaration form to acknowledge their understanding of this policy when they submit their essays for assessment.

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