

CHEM8014: NANOCHEMISTRY AND NANOBIO TECHNOLOGY

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Nanochemistry and Nanobiotechnology

Subject Code

CHEM - Chemistry

Course Number

8014

Academic Unit

Chemistry (CHEM)

College/School

College of Science (SI)

Course Duration

One Semester

Credit Units

3

Level

R8 - Research Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

Nil

Equivalent Courses

BCH8014 Nanochemistry and Nanobiotechnology

Exclusive Courses

Nil

Part II Course Details

Abstract

This course enables postgraduate students to have a general knowledge of nanoscience from nanohistory, nanofabrication, characterization and corresponding applications. Special focus will be on bottom-up wet chemistry preparation and post treatments (e.g. phase transfer/surface modification) of nanoparticles ranging from metal, metal oxide to quantum dot and their property-directed applications. Most importantly, students will be able to explain some phenomena observed in nanoscience by what they have learned in inorganic chemistry (e.g. ligand-chelating, HOMO-LUMO tuning...) and physical chemistry (e.g. colloidal and surface chemistry, flocculation state, thermodynamic/kinetic control, quantum confinement...). In addition, nanobiotechnology has become an emerging interdisciplinary area in this field for researching and solving biological phenomena and problems using nanochemistry and nanomaterials. For example, nanomaterials can serve as signalling nanoprobe, nanotools that manipulate mechanical forces, and vehicles that deliver drugs or biomolecules. A brief and intuitive introduction of nanomaterials and the characteristics and applications of nanobiotechnology will be presented at a level accessible to graduate students interested in nanomedicine, materials science, nanochemistry, and nanomaterials.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Review the development of nanofabrication and characterization tool and critically evaluate their advantages, limitations and challenges for research and application in nanoscience.	25	x	x	
2	Identify the role and function of nanocomponent in current artificial products and objects from the nature world and rationalize phenomena observed in nanoscience by what they have learned from chemistry textbook.	25	x	x	x
3	Critically evaluate the principles and strategies for nanomaterials used in the literature especially in field of biotechnology and effectively communicate this knowledge within their peers.	25	x	x	x
4	Design experiments to explore the principles in nanobiotechnology and evaluate current literature on novel approaches in corresponding applications.	25		x	x

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

LTAs		Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will learn the general background of nanoscience including preparation, characterization, applications of a wide range of nanoparticles and explain key phenomena observed in nanoscience from chemistry point of view. Special focus of applications will be put on nanobiotechnology.	1, 2, 3	3 hrs/wk for 8 weeks
2	Literature review	Students will independently review current research articles in nanobiotechnology and related areas. Teaching and learning will entail extensive teacher-student interaction and supervised in-depths discussion among the students based on recent primary research articles, in order to foster independent and critical thinking of the students.	1, 2, 3	3 hrs/wk for 1 week
3	Group activities (Presentations and assignments)	Students will work in small groups to create the ideas and present the selected topics. Assignment will be given for students to demonstrate the ability of literature search and create an idea with peers. Team work is emphasized in the form of group presentation and assignment of selected projects.	3, 4	3 hrs/wk for 2 weeks

Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Individual Presentation	1, 2, 3	20	-	Yes
2	Individual Assignment	1, 2, 3	20	-	Yes
3	Class Discussion	1, 2, 3, 4	10	-	Yes

4	Group Presentation and Assignment	3, 4	50	-	Yes
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Continuous Assessment (%)

100

Examination (%)

0

Minimum Continuous Assessment Passing Requirement (%)

40

Assessment Rubrics (AR)**Assessment Task**

Individual presentation (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Ability to analyse, discuss, organize and defend their own investigation relevant to nanobiotechnology.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Individual assignment (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Ability to analyse and discuss problems to understand the topics of nanobiotechnology.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Class Discussion (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Ability to participate in discussion.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Group presentation and assignment (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

1. Ability to communicate and create the ideas with colleagues.
2. Ability to analyse and evaluate and scientific problem/issues.
3. Ability to integrate the knowledge in this lecture to their interesting research.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Individual presentation (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Ability to analyse, discuss, organize and defend their own investigation relevant to nanobiotechnology.

Excellent

(A+, A, A-) High

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(B+, B) Significant

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(B-, C+, C) Basic

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Part III Other Information**Keyword Syllabus**

Definition of nanomaterial/nanotechnology and their general properties, Nanohistory, Cluster, Nanocomponent in artificial products/nature objects, Nanofabrication, Characterization, Wet chemistry preparation and post treatments, Colloidal chemistry, Surface chemistry, Aggregation and flocculation states, Thermodynamic/kinetic controlled particle growth and stability, Superparamagnetic/Plasmonic/Quantum confinement properties, Emerging fields of Nanobiotechnology, Nanobiosensor, Nanobioimaging, Drug delivery, Therapy, Nanodevice

Reading List**Compulsory Readings**

	Title
1	K. S. Birdi, Handbook of Surface and Colloid Chemistry (4th ed), CRC Press, 2015.
2	J.-C. Joud and M.-G. Barthés-Labrousse, Physical Chemistry and Acid-base Properties of Surfaces, Wiley, 2015.
3	G. E. J. Poinern, A Laboratory Course in Nanoscience and Nanotechnology, CRC Press, 2015.
4	Appropriate selected research papers. To be provided, as required.

Additional Readings

	Title
1	Nil