MSE8017: MATERIALS CHEMISTRY

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Materials Chemistry

Subject Code
MSE - Materials Science and Engineering
Course Number
8017

Academic Unit
Materials Science and Engineering (MSE)

College/School
College of Engineering (EG)

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
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course is aimed at providing both the generalized understanding and in-depth knowledge on certain selected subjects on materials chemistry. It will also provide substantial chemistry foundation for students from a non-chemistry

background. It started with a lecture on the fundamental of materials chemistry, followed by a series of lectures on chemistry principles including quantum chemistry, molecular structures, chemical bonding, molecular orbital theory and coordination complex, intermolecular forces, band theory of solid, basic organic chemistry, and fundamental electrochemistry and associated applications. It will also include one lecture on chemistry of the emerging two-dimensional materials. Upon successful completion of the course, students are expected to gain sufficient knowledge on chemistry of materials, including the fundamental principles behind essential chemical reactions and materials properties, as well as potential applications targeting at solving various material issues on future technologies.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamental concepts of materials chemistry.	5	x	x	
2	Explain the fundamentals of chemical principles quantum theory, atomic orbitals, molecular structures chemical bonding, coordination complex, intermolecular forces.	50	x	x	
3	Explain the fundamentals of organic and polymer materials.	15	x	x	
4	Explain the fundamentals of molecular orbital theory band theory and the properties of semiconductor materials.	15			
5	Explain the fundamental electrochemistry and applications in harvesting and storing energy.	15	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	Lecture	Students will engage in formal lectures to gain knowledge about materials chemistry. The lectures are divided into 9 chapters covering quantum theory, atomic orbitals, molecular structures chemical bonding, coordination complex, intermolecular forces, molecular orbital theory and band theory of solid, basic organic chemistry, and fundamental electrochemistry and associated applications	1, 2, 3, 4, 5	2
2	Tutorial	Students will engage in tutorial activities to solving related questions and reinforce the knowledge base.	1, 2, 3, 4, 5	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Midterm Exam (duration: 2 hours)	1, 2	40	-	No

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Assessment Rubrics (AR)

Assessment Task

Midterm test (applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Demonstrate sufficient understanding on fundamental principles of quantum theory, atomic orbitals, chemical bonds.

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
Examination (applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Demonstrate sufficient understanding on fundamental principles of coordination complex, intermolecular forces, molecular orbital theory and band theory of solid, basic organic chemistry, and fundamental electrochemistry. Capable to describe basic chemistry theories explain all fundamental properties of materials taught in this series of lectures.

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
Midterm test (applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Demonstrate sufficient understanding on fundamental principles of quantum theory, atomic orbitals, chemical bonds.

Excellent
(A+, A, A-) High

Good
(B+, B) Moderate

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task

Examination (applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Demonstrate sufficient understanding on fundamental principles of coordination complex, intermolecular forces, molecular orbital theory and band theory of solid, basic organic chemistry, and fundamental electrochemistry. Capable to describe basic chemistry theories explain all fundamental properties of materials taught in this series of lectures.

Excellent

(A+, A, A-) High

Good

(B+, B) Moderate

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

(a) Fundamentals that underlie materials chemistry
(b) Fundamentals of quantum chemistry
(c) Fundamentals of chemical bond, molecular structures and coordination complex
(d) Fundamental of molecular orbital theory and band theory of solid
(e) Fundamental of intermolecular forces
(f) Fundamentals and applications of organic chemistry
(g) Fundamentals on electrochemistry and relevant applications
(h) Chemistry of two-dimensional materials

Reading List

Compulsory Readings

	Title
1	Lecture slides
2	Tutorial problems and solutions

Additional Readings

	Title
1	Harry R. Allcock, "Introduction to Materials Chemistry, 2nd Edition", John Wiley & Sons Inc. (2019)
2	Anthony R. West, "Solid State Chemistry and its Applications, 2nd Edition", John Wiley & Sons Inc. (2014)
3	Bradley D. Fahlman "Materials Chemistry 3rd Edition", Springer Nature, (2018).