MSE2108: 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
2108

Academic Unit
Materials Science and Engineering (MSE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
*CHEM1300 Principles of General Chemistry

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
* This pre-requisite requirement is waived for Advanced Standing I students (admitted in 2014/15 and thereafter) and Advanced Standing II students (admitted in 2013/14 and thereafter).

Part II Course Details

Abstract

This course will provide students with sufficient knowledge in basic principles of chemistry and their applications to materials science and engineering. This course aims to enable students to build up fundamental knowledge in basic chemistry, chemical synthesis, materials chemistry,and materials science in order to proceed to the intermediate and more advanced course in the BEng Materials Science and Engineering programme.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain fundamental knowledge in various disciplines of materials chemistry		x		
2	Compare and contrast the relationship of between basic principles of chemistry, chemical synthesis, and materials science and engineering in examining different engineering systems			x	
3	Compare and contrast the utilization of materials chemistry to solve materials science and engineering related problems in a qualitative manner			x	x
4	Analyze, interpret and correlate chemical principles, synthetic and analytical methods in the field of materials chemistry to explain the properties of both the synthetic materials and naturally occurred materials			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 lecture activities about working principles and key concepts of basic chemical principles, synthetic methods, and materials chemistry and properties in an interactive manner.	1, 2, 3, 4	3 hrs/wk

2	Tutorial	Students will take short quizzes related to key topics learned in lecture, and provide the proper solutions to the questions given by their course leader and teaching assistants.	1, 2, 3, 4	1 hr/wk

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Test	1, 2, 3, 4	20	Mid-term Test	No
2	Assignments	1, 2, 3, 4	20	Take home assignments	No

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Test

Criterion

Able to solve numerical problems, and demonstrate an understanding of basic principles

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching the marginal level

Assessment Task
3. Assignments

Criterion
Able to solve numerical problems, and demonstrate an understanding of basic principles

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching the marginal level

Assessment Task
4. Examination

Criterion
Able to solve numerical problems, and demonstrate an understanding of basic principles

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching the marginal level

Part III Other Information

Keyword Syllabus

- The application of basic chemical principles to problems in materials discovery, design, and characterization will be discussed. Topics covered will include:
  - Introductory quantum chemistry
  - Symmetry and group theory, crystal field theory, and molecular orbital theory and band theory
  - Basic organic and organometallic chemistry
  - Background to basic chemical synthesis and reaction chemistry

- Chemistry of representative elements utilized in materials science
- Structure determination and special techniques for materials characterization
- Non-covalent interactions, small molecules in solids, porous solids, and surfaces and interfaces
- Basic electrochemistry and catalysis
- Materials addressed include small molecules, polymers, biopolymers, nanoscale materials, ceramics and glasses, optical materials and metallic, semiconductor and silica nanoparticles, etc., with specific focus on the ways in which atomic-level interactions dictate the bulk properties of materials.

Reading List

Compulsory Readings

	Title
1	Allcock, Harry R. Introduction to Materials Chemistry, 2nd Ed., Wiley 2020.

Additional Readings

	Title
1	Miessler, G. L., Tarr, D. A. Inorganic Chemistry,5th Edition, Pearson Education, 2014.
2	DeKock and Gray, Chemical Structure and Bonding, 2nd Ed., University Science Books, 1989
3	Raymond Chang, Chemistry, 10th Edition, McGraw-Hill, Inc, 2009.
4	Robert C. Atkins, Francis A. Carey, Organic Chemistry: A Brief Course, 3rdEdition, McGraw-Hill, Inc, 2002.
5	TWG Solomons and CB Fryhle, Organic Chemistry, 9th Edition, John Wileyand Sons Inc., 2008.