SEE4120: MATERIALS ENGINEERING FOR ENERGY APPLICATIONS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Materials Engineering for Energy Applications

Subject Code
SEE - School of Energy and Environment
Course Number
4120

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
SEE2001 Electromagnetic Principles for Energy Engineers or equivalent;
SEE2002 Chemical Sciences for Energy and Environmental Engineers or equivalent; and
SEE2101 Engineering Thermofluids I or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

Material is an essential component for sustainable development. For example, wind turbines and dam require the use of structural materials; solar cells require the use of electrical and optical materials; heating/cooling and energy storage require the use of materials with phase change/transformation; batteries require the use of materials with diffusive properties. This course will introduce basic materials structure, properties and characterizations, and apply them to energy applications.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Discover the different materials for sustainable development	10	x	x	
2	Describe the fundamental materials properties and characterization methods associated with different energy technologies	40		x	
3	Analyze mechanical and thermal systems for energy applications	50		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 lectures with facilitated and interactive discussion to gain key concepts of materials engineering, such as materials properties relevant in energy applications.	1, 2, 3	2.5
2	Tutorial sessions	Students will go through practice problems and examples, as provided and guided by the instructor, in order to solidify the concepts learned during lectures.	1, 2, 3	0.5

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	In-class test There will be 1 midterm quiz for instructor to assess students' learning progress.	1, 2, 3	20	
2	Assignment There will be 3-4 assignments throughout the semester. Students will complete the assignments to demonstrate their understanding on the concepts delivered during lectures and tutorial sessions.	1, 2, 3	40	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs
Percentage of continuous assessment, examination, etc.: 60% by continuous assessment; 40% by examination

To pass a course, a student must do ALL of the following:
1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. In-class test

Criterion

Ability to describe and analyse materials properties and characterizations

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
2. Assignment

Criterion
Ability to evaluate and analyse questions related to materials properties and characterization

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
3. Final exam

Criterion
Ability to analyse and solve practical problems related to energy applications

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

Part III Other Information

Keyword Syllabus

- Materials classifications and properties
- Crystal structures and defects
- Stress and strain
- Microstructure and characterization
- Phase transformation, phase diagram and diffusion
- Electric and optical properties of materials
- Applications to energy applications
- Materials selection and criteria

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Materials Science and Engineering: an Introduction, 10th edition, William D. Callister, Jr. and David G. Rethwisch, John Wiley & Sons, Inc. 2018.
2	Engineering Material 1, Michael F. Ashby and David R. H. Jones, Butterworth Heineman, 1997.
3	Engineering Material 2, Michael F. Ashby and David R. H. Jones, Butterworth Heineman, 1997.
4	Engineering Materials Science, Milton Ohring, Academic Press 1995.
5	The Mechanics of Engineering Structures, David W. A. Rees, Imperial College Press, 2015.
6	Materials Science for Engineers, James F. Shackelford, 6th edition, Prentice Hall, 2005.
7	Introduction to Structural Analysis & Design, S. D. Rajan, John Wiley & Sons, Inc. 2001.
8	Examples in Structural Analysis, William M. C. McKenzie, Taylor & Francis, 2006.
9	Materials Selection in Mechanical Design, 5th edition, Michael F. Ashby, Elsevier, 2017.