GE1340: MATERIALS, CIVILIZATION AND MODERN DEVELOPMENT

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Materials, Civilization and Modern Development

Subject Code
GE - Gateway Education
Course Number
1340

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

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

GE Area (Primary)
Area 3 - Science and Technology

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

Human civilization has been classified as Stone Age, Bronze Age, Iron Age, and Silicon Age. In essence, it is based on the control of fire or temperature in processing materials for quality improvement of human life. The success of materials applications has impacted the well-being of people. Examples in clothing, food processing (which can also be studied under materials science), housing, and transportation are ubiquitous. Sword making, musical instrument, china, and lithographic printing, etc., have all impacted the development of our advanced civilization. While the above examples are focusing on the technological advancements, Art Nouveau was an example of success of materials manipulation by artists. On the other hand, the sinking of Titanic and the collapse of World Trade Center are very sad events in human history due to steel failure at low and high temperatures, respectively. The evolution of mobility solutions (airplane, car and train) will be introduced. Silicon technology is playing a significant role in our IT-based society, which is affecting our daily life significantly. The cost of making one transistor on a silicon chip nowadays is even cheaper than the printing of one alphabet on a newspaper. Today, the world is facing the task of sustainable development, the success of which hinges on the R&D in materials science that can support the needed new technologies. In this course, the historical trends of materials processing and development, the basic physical properties of materials, the challenge in applications of new materials, and the future of materials in sustainable development will be covered. In this course, students will be guided into the amazing world of "MATERIALS" by a series of lectures and carry out a group project.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the historical relationships of materials discovery and the different stages of human civilization developments, i.e. Stone, Bronze, Iron, and Silicon Ages.			x	
2	Classify the basic properties of various structural and functional materials from the technological perspective.		x	x	
3	Explain how developments in materials technology impact the industrial revolution and quality of life from historical perspectives.		x	x	x
4	Reflect the importance of the development of new materials on modern and sustainable development.			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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Histories of materials advancement on the development of human civilization through the Stone Age, Bronze Age, Iron Age and modern age during human civilization. The easing of the urgent needs for sustainable development.	The ancient development indicated the control of firing and temperature is the key to develop new materials, including pottery, bronzes and irons.	1	4/week 1-2
2	Classification of materials based on atomic bonding, crystalline structures, and microstructural features.	Provide basic knowledge to understand atomic and crystal lattice structures of various materials.	2	8/week 2-4
3	Basic properties of various structural materials and material processing/development.	Briefly mention all physical, mechanical and metallurgical properties of materials and the ways to fabricate and process various materials.	2	3/week 5
4	Material processing/ development and quality of life.	To develop the structure-properties correlations.	2, 3	3/week 6
5	Basic properties of various functional materials and material processing/development.	Briefly mention functional properties of materials and the ways to fabricate and process various materials	2, 3	6/week 7-8
6	Laboratory visit and demonstration.	Experimental and computational tools used in the development and characterization of advanced materials. Students will be demonstrated to the study of materials with the smallest dimensions using available technology.	4	3/week 9
7	Correlation of advanced material development with high-tech industries, and potential solutions for sustainable development.	Briefly mention the requirement of advanced materials with special properties for high-tech application.	4	3/week 10
8	Group discussion and presentation.	Conduct laboratory and field trip work.	1, 2, 3, 4	3/week 11-12

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	In-class Quiz (individual)	1, 2, 3, 4	20	In-class quiz
2	Homework Assignments	1, 2, 3, 4	20	Total 4 homework assignments
3	Group Project and Report (team work)	3, 4	30	Special report for laboratory work or laboratory/museum visit

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

1. In-class Quiz (individual)

Criterion

To determine the level of understanding of the lectured materials.

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. Homework Assignments

Criterion

To determine the level of understanding of the lectured materials.

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. Group Project and Report (team work)

Criterion
To conduct the experimental work or make field trips for special exhibitions.

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
4. Examination

Criterion
To determine the level of understanding of the lectured materials.

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

Additional Information for AR

Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

- Historical classification of Human civilization
- Atomic structure and classification of materials
- Physical and mechanical properties of materials
- Materials and quality of life
- Modern structural and functional materials
- Material processing, fabrication and analysis
- Advanced materials, technology innovation and industrial development
- Sustainable development

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	“Understanding Materials Science: History, Properties and applications”, by Rolf. E. Hummel, Springer, Second Edition, 2004.
2	“The Substance of Civilization”, by Stephen L. Sass, Arcade Publication, New York, 1998.
3	“Materials Science and Engineering; An Introduction”, by W. D. Callister, John Wiley & Sons, Inc., 2007.

Annex (for GE courses only)

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

Please indicate which CILO(s) is/are related to this PILO, if any (can be more than one CILOs in each PILO)

PILO 1: Demonstrate the capacity for self-directed learning

2, 3, 4

PILO 2: Explain the basic methodologies and techniques of inquiry of the arts and humanities, social sciences, business, and science and technology

1, 2, 3, 4

PILO 3: Demonstrate critical thinking skills

3, 4

PILO 4: Interpret information and numerical data

3, 4

PILO 6: Demonstrate effective oral communication skills

4

PILO 7: Demonstrate an ability to work effectively in a team

4

PILO 8: Recognise important characteristics of their own culture(s) and at least one other culture, and their impact on global issues

1, 3

PILO 10: Demonstrate the attitude and/or ability to accomplish discovery and/or innovation

1, 3, 4

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task

Group project reports.