GE2309: THE WORLD OF NANO: THE NEXT BIG THING IS REALLY SMALL

Effective Term
Semester B 2022/23

Part I Course Overview

Course Title
The World of NANO: The Next Big Thing Is Really Small

Subject Code
GE - Gateway Education
Course Number
2309

Academic Unit
Materials Science and Engineering (MSE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
A1, A2 - Associate Degree
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

NANO as a synonym for very small scale (1 nanometer is 0.000000001 meter) is a word that has now left the science reservation and entered the public consciousness. The field of nanoscience with its promise of amazing nanotechnologies is one of today’ s most challenging, exciting, multidisciplinary and competitive fields, and one of the most highly funded. One might imagine it as a pretty specialized field, while in reality it is just the opposite. In NANO, the idea is to do something really big and important with objects that are really small. It is a field full of challenges that cannot be met by any one specialist of any particular scientific field. In order to be competitive in the global education and economy, Hong Kong universities and emerging nanotechnology companies need creative and competent personnel trained to cross borders between scientific fields. Being interdisciplinary by definition, NANO is the field of science and technology perfectly suited to provide this kind of training to natural science, health science, and engineering students. Moreover, this is the emerging field where the students from social sciences, humanities, business and media need basic knowledge, both in order to provide further education for the public about the scientific, technological and ethical issues of NANO and to be able to critically analyze decisions of policy makers and plan future important financial investments.This course does not require and does not utilize any subject-specific knowledge (no math!). Two field trips will be arranged to visit modern nanotechnology facilities at CityU and at the Hong Kong Science Park.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Demonstrate the capacity for self-directed learning on topics related to nanoscience and nanotechnology.	25			x
2	Understand the basic methodologies and techniques used to create and to study nanomaterials in their basic different forms.	15	x		
3	Demonstrate critical thinking skills by comparing special properties of nanomaterials with their bulk counterparts (large objects with which we are all familiar).	20		x	
4	Demonstrate critical thinking skills and ability to identify potential risks associated with nanoscale objects.	20		x	
5	Demonstrate an ability to work effectively in a team by showing active participation on assigned group project.	20		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	Lecture	Understand key concepts and engage in inquiry	2, 3, 4	2 hrs/wk for 9 weeks
2	Tutorial activity	Demonstrate the capability of analysis and critical thinking	2, 3, 4	1 hrs/wk for 9 weeks
3	Field trip	Appreciate modern technology developments	1, 2, 3, 5	3 hrs/week for 2 weeks
4	Group project	Take on the role of expert introducing concepts in NANO for the students	1, 2, 3, 4, 5	3 hrs/week for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Group project presentation	1, 2, 3, 4, 5	45	
2	Homework essays and tutorial quizzes	1, 3, 4	25	
3	Field trip reports	2, 3, 5	30	

Continuous Assessment (%)

100

Examination (%)

0

Assessment Rubrics (AR)

Assessment Task

1. Discussion at tutorial

Criterion

CAPACITY for SELF-DIRECTED LEARNING to understand the principles

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. Quiz

Criterion
ABILITY to EXPLAIN methodologies

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. Homework essay

Criterion
ABILITY to GENERATE new concepts

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. Field trip report

Criterion
ABILITY to REFLECT on modern technologies

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
5. Final examination

Criterion
ACCOMPLISHMENT to PRODUCE creative solutions

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

- "More than just a size" * – What is so special about NANO. History of NANO.
- "NANO in our daily life" ** – Examples of real-world applications and products based on nanoconcepts and utilizing nanomaterials.
- "How can we see NANO?" ** – Operating principles and current status of modern methods and techniques enabling characterization of materials at the nanoscale.
- "How can we make NANO?" ** – Introduction to modern approaches and techniques used by scientists to produce nanoscale materials.
- "Small is different" * – Overview of useful properties of nanomaterials different from the large objects with which we are all familiar.
- "NANO for health" ** – Overview of benefits of nanomaterials and nanoconcepts for biology and medicine.
- "Nanotechnology fabricates self-replicating nanorobots which will overrun the earth…" * – Policy makers and public perception of NANO, ethical implications and potential risks.
- "What comes next?" ** - Future challenges, future developments, future successful investments.

* core principals/concepts

** essential principals/concepts

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nanotechnology : a gentle introduction to the next big idea / Mark Ratner, Daniel Ratner. Upper Saddle River, NJ : Prentice Hall, c2003. (T174.7 .R38 2003)
2	Nanotechnology demystified / Linda Williams, Wade Adams. New York : McGraw-Hill, c2007. (T174.7 .W55 2007) (T174.7 .W55 2007eb World Wide Web)
3	Introduction to nanotechnology / Charles P. Poole, Jr., Frank J. Owens. Hoboken, NJ : J. Wiley, c2003. (T174.7 .P66 2003)
4	Nanobiotechnology : concepts, applications and perspectives / edited by Christof M. Niemeyer and Chad A. Mirkin. Weinheim : Wiley-VCH, c2004. (TP248.25.N35 N36 2004)

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

1

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

2

PILO 3: Demonstrate critical thinking skills

3

PILO 4: Interpret information and numerical data

2, 3

PILO 5: Produce structured, well-organised and fluent text

1

PILO 6: Demonstrate effective oral communication skills

5

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

5

PILO 9: Value ethical and socially responsible actions

4

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

1

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 Presentations (pdf of Power Point slides prepared/presented by the students)