

GE2318: COMPLEXITY IN SCIENCE AND TECHNOLOGY

Effective Term

Semester B 2023/24

Part I Course Overview

Course Title

Complexity in Science and Technology

Subject Code

GE - Gateway Education

Course Number

2318

Academic Unit

Electrical Engineering (EE)

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

New sciences is not developed at random or from scratch, but instead rooted in knowledge and wisdom. This course is to open up students' mind to welcome the scientific knowledge and wisdom (such as Complexity in Networks, Chaos, Fractals, and AI) and to guide the students to witness how these pieces of knowledge were developed and how they can light up the modern sciences, thereby helping them to improve their innovative ideas and cognitive skills. Through the lectures, students will be able to grasp some major concepts of general scientific knowledge and technology, and understand some core ideas in a few selected modern scientific fields (specifically, complex networks, chaos theory, fractals, intelligent systems and complexity). Throughout course learning and after-class reading, students will be able to experience the close relationships among the long-lasting scientific knowledge, the rapidly-evolving modern science notions, and their daily-life activities and applications.

This course aims to enhance the appreciation of close relationship between the fundamental knowledge and the advancements of contemporary science and technology, including topics such as complex networks, chaos, fractals, and intelligent systems. It also serves as an introductory course in life philosophy that could enrich students' life-long learning and personal development.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 DEC-A2 DEC-A3 app.)			
1	Describe the major concepts of some selected knowledge and wisdom, such as chaos, fractals and nonlinear science.		x	x	
2	Describe the major concepts in some selected modern scientific topics, such as network science and complexity in modern science and technology.			x	
3	Identify the relationship between fundamental knowledge and modern sciences			x	
4	Describe daily-life phenomena from a scientific perspective			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	Lectures	Explain key concepts of the related topics in the course.	1, 2, 3, 4	3 hrs/wk for 13 weeks

2	Self-learning activities	Possible activities include self-reading and self-study of hand-out materials.	1, 2, 3, 4	N.A.
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Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)	
1	Test (min: 2)	1, 2, 3, 4	40	One mid-term test and one open-book learning report
2	#Assignments (min: 3)	1, 2, 3, 4	10	One HW assignment per week, except the first week and the last week

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Remark:

To pass the course, students are required to achieve at least 30% in the continuous assessment and 30% in the examination.

may include homework and self-learning report

Assessment Rubrics (AR)**Assessment Task**

Examination

Criterion

Achievements in CILOs

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

Coursework

Criterion

Achievements in CILOs

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**1. Complex Networks

System complexity, complex networks, graph theory, Internet, power grid, human dynamics, social networks, network synchronization, network control

2. Chaos

Background and history, chaotic systems, characteristics, applications

3. Fractals

Background, self-similarity, fractal structures, fractal patterns, applications

4. Intelligent systems:

Background, neural networks, machine learning, fuzzy logic, applications

Reading List**Compulsory Readings**

Title	
1	Nil

Additional Readings

Title	
1	Texts on Complexity and Complex Networks[A1]Guanrong Chen, Xiaofan Wang, and Xiang Li, “Fundamentals of Complex Networks: Models, Structures and Dynamics,” Singapore: Wiley, 2015. (E book available) [A2] Shlomo Havlin, “Complex Networks: Structure, Robustness and Function,” Cambridge University Press, 2010. [A3]Mark Newman, “Networks: An Introduction,” Oxford University Press, 2010.
2	Texts on Fractals [B1]Heinz-Otto Peitgen, Hartmut Jürgens, Dietmar Saupe, “Fractals for the Classroom,” Springer-Verlag, 1992.
3	Online Reading Materials http://www.apophysis.org/tutorials/index.html https://en.wikipedia.org/wiki/Network_science

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

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

1, 2

PILO 3: Demonstrate critical thinking skills

3, 4

PILO 4: Interpret information and numerical data

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

Examination