EE6605: COMPLEX NETWORKS: MODELING, DYNAMICS AND CONTROL

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Complex Networks: Modeling, Dynamics and Control

Subject Code
EE - Electrical Engineering
Course Number
6605

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
MA3150 Advanced Mathematical Analysis or equivalent

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The aim of this course is to provide students with a good understanding of basic concepts, techniques and principles of complex networks: their modelling, dynamics and control.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Apply basic concepts to describe representative network models		x	x	x
2	Analyze the effects of network structures on dynamical behaviors		x	x	x
3	Estimate local and global network stability, synchronizability and controllability		x	x	
4	Develop small-scale efficient virus-spreading control algorithms		x	x	
5	Describe the control of data traffic flows and network topological effect		x	x	
6	Apply the learned techniques to solve some practical problems			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	Illustrate basic concepts Demonstrate basic properties Show typical applications	1, 2, 3, 4, 5	3 hrs/wk
2	Weekly homework	Illustrate basic concepts Demonstrate basic properties Show typical applications	1, 2, 3, 4, 5	2 hrs/wk
3	Take-home term project (4 weeks)	Initiate innovative ideas Develop individual designs Perform computer programming	6	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Tests (min.: 2)	1, 2, 3, 4, 5, 6	40	One mid-term test and one end-term test	No
2	#Assignments (min.: 3)	1, 2, 3, 4, 5	10	8 to 10 sets of HWs	Yes

Continuous Assessment (%)
50

Examination (%)
50

Examination Duration (Hours)
2

Minimum Continuous Assessment Passing Requirement (%)
30

Minimum Examination Passing Requirement (%)
30

Additional Information for ATs
Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.
may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task
Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

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 level

Assessment Task
Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

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 level

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 1,2,3,4,5 Lecturing is the core of teaching. Reading materials will be suggested. One homework assignment will be given each week, for week 2 - week 7. One largescale computer project will be assigned for week 8 - week 12 to complete.

PILO 6 The take-home project requires self-motivated design and significant computer simulation demonstrating network science knowledge with clear real-world application background and implication. This project is research-oriented, requiring some new ideas and new techniques to complete.

Part III Other Information

Keyword Syllabus

Network Structures and Properties
Recent advances in scientific literature including the complexity of models; degree distributions; random graphs; small-world features; scale-free properties; basic network modeling
Elementary Graph Theory
Basic concepts; elementary properties; typical algorithms; graph applications
Network Dynamics
Network dynamical behaviors; stability and synchronization; network game; community structures; opinion dynamics; evolving networks
Network Performances
Internet topology; data traffic; epidemics spreading; cascade failures
Network Synchronization and Control
Network synchronization phenomena and criteria; network stabilization and pinning control; data traffic congestion control; network synchronizability and controllability
Potential Engineering Applications
Internet; power grids; transportation networks; social networks
Research-Oriented Computer project
A self-designed, self-performed and self-analyzed computer-programming project, using basic complex-network knowledge learned from the course

Reading List

Compulsory Readings

	Title
1	Lecture Notes

Additional Readings

	Title
1	G. R. Chen, X. F. Wang and X. Li Introduction to Complex Networks: Models, Structures and Dynamics, High Education Press, Beijing, China, January 2015
2	X. F. Wang, X. Li and G. R. Chen, Network Science: An Introduction (in Chinese), High Education Press, Beijing, China, April 2012