Form 2B

City University of Hong Kong

Information on a Course offered by Department of Electronic Engineering with effect from Semester A 2011/12

Part I

Course Title: Linear Systems Theory and Design

Course Code: EE5411

Course Duration: One Semester (13 weeks)

No. of credits: 3

Level: P5

Medium of Instruction: English

Prerequisites: Nil

Precursors: MA2170 Linear Algebra and Multi-variable Calculus, or
EE3210 Signals and Systems, or
EE3118 Linear Systems and Signal Analysis

Equivalent Course: Nil

Exclusive Courses: Nil

Part II

Course Aims:

This course aims to introduce to students fundamental concepts, techniques, and tools in linear system analysis and design, required for a broad range of engineering disciplines including systems and control, signal processing, and communications.

Course Intended Learning Outcomes (CILOs)
Upon successful completion of this course, students should be able to:

No.	CILOs
1.	Recognise and determine system characteristics
2.	Describe and apply state-space modelling
3.	Implement the solution/response of linear dynamical systems
4.	Describe and apply controllability and observability to linear systems
5.	Apply state feedback and state estimator to engineering design
6.	Apply stability of linear systems to modern engineering design

Teaching and Learning Activities (TLAs)

(Indicative of the possible activities and tasks designed to facilitate students' achievement of the CILOs. Fine details will be provided for students upon the commencement of the course.)

CILO 1, 2, 3, 4, 5, 6	Lectures, tutorials, written assignments
CILO 4, 5, 6	Case studies, presentation

<u>Timetabling Information</u>

Pattern	**Hours**
Lecture:	*26*
Tutorials:	*13*
Laboratory:	
Other activities:	

Assessment Tasks/Activities

(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)

	Type of assessment tasks	*Weighting (if applicable)*
Continuous Assessment	Written assignments, case studies, and presentation	50%
Examination	Written examination	50% 2 hours

Remarks:. To pass the course, students are required to achieve at least 35% in course work and 35% in the examination.

Grading of Student Achievement:

Letter Grade	**Grade Point**	**Grade Definitions**
A+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
D	1.0	Marginal
F	0.0	Failure

Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1, 2	The course will provide fundamental concepts and techniques required in the modeling, analysis, and design of modern engineering systems in broad fields such as control technology, communication systems, and signal processing algorithms.
3, 4	Student will be able to analyze and design state feedback and state observors, and consequently to analyze and design feedback systems using numerically efficient state-space methods.
5	The lectures will provide the necessary tools for students to access contemporary research developments. The case studies will expose students to new research frontiers.
6,7	The case studies and presentation will provide students with the opportunity to work as a team and to develop their communication skills.

Part III

Keyword Syllabus:

Mathematical Systems Descriptions

Review of basic concepts, causality, stability, linearity, time-invariance, input-output description, state-space description, LTI systems, linearization.

Basic Mathematical Background

Linear space, vector norms, linear equations, linear transformation, eigenvalues and eigenvectors, canonical forms, matrix function, positive definite matrices, matrix induced norms.

Linear Dynamical Equations

Solution space, fundamental matrix, transition matrix, adjoint systems, equivalent systems.

Controllability and Observability

Controllability Gramian, rank test, PBH test, output controllability, observability Gramian, observability test, PBH test, duality, canonical forms, canonical decomposition, minimal realizations.

State Feedback and Observor

State feedback, pole placement, full-state observor, reduced state observor, separation principle, tracking and regulation.

Stability Analysis

Input-output stability, system induced norms, internal stability, Lyapunov stability, Lyapunov equation.

Recommended Reading:

C.T. Chen, Linear System theory and Design, 3rd Ed., Oxford Univ. Press, 1999
Online Resources (if any)