City University of Hong Kong
Course Syllabus

offered by Department of Systems Engineering & Engineering Management
with effect from Semester A 2017 / 18

Part I   Course Overview

Course Title: Estimation and Control of Random Dynamic Systems

Course Code: SEEM6101

Course Duration: One Semester

Credit Units: 3

Level: P6

Medium of Instruction: English

Medium of Assessment: English

Prerequisites:
(Course Code and Title) Nil

Precursors:
(Course Code and Title) Nil

Equivalent Courses:
(Course Code and Title) Nil

Exclusive Courses:
(Course Code and Title) Nil

The course is self contained, but requires motivated students, interested in learning mathematical techniques for systems control.

Part II   Course Details

1.   Abstract

This course aims to teach the students the basic concepts and methods related to random dynamic systems. They apply to dynamic systems originated from Engineering as well as from Economics. General principles as well as more specific techniques will be presented.

The state representation approach will be used. The way decisions are taken will be explained, in relation with the available information. The concept of feedback control will be discussed.

The course will develop estimation techniques, for identification as well as for forecasting. In particular the Kalman filter will be fully presented.

Particular attention will be devoted to the Dynamic Programming approach to define optimal control. We will also present Pontryagin's Maximum principle.   Examples will be developed. Special attention will be given to solving linear quadratic problems, by direct methods. Attention will be devoted to studying the stability of dynamic systems. Riccati equations will be fully solved in this context.

2.   Course Intended Learning Outcomes (CILOs)
(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Model dynamic systems with uncertainties	20%	✓		
2.	Forecast the behaviour of the system in the future	10%	✓		
3.	Decide control variables according to objectives	15%		✓	
4.	Define prototypes with increasing complexity	10%	✓		
5.	Apply mathematical techniques for dynamic systems analysis	45%		✓	
		100%			

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	Presentation and discussion	✓	✓	✓	✓	✓	26 hours/sem
Tutorial	Help to assignments	✓	✓	✓	✓	✓	13 hours/sem

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.					Weighting	Remarks
	1	2	3	4	5		
Continuous Assessment: 100 %							
Assignment	✓	✓	✓	✓	✓	33%	
Term Paper/Project	✓	✓	✓	✓	✓	33%	
Oral Presentation	✓	✓	✓	✓	✓	34%	
Examination: 0 % (duration: , if applicable)							
						100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Correctness of results	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Term Paper/Project	Creativity, team work	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Oral Presentation	Clarity, synthesis	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III   Other Information (more details can be provided separately in the teaching plan)

1. **Keyword Syllabus**
    (An indication of the key topics of the course.)

    - Dynamic Systems
    - Uncertainty
    - Control Theory
    - Dynamic Programming
    - Estimation
    - Filtering
    - State of System
    - Decision Variables
    - Optimization

2. **Reading List**
2.1 **Compulsory Readings**
    (Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Lecture Notes

2.2 **Additional Readings**
    (Additional references for students to learn to expand their knowledge about the subject.)

1.	Supplementary Reading: A. Bensoussan, *Dynamic Programming and Inventory Control* (IOS Press 2011)