Tamkang University Academic Year 104, 2nd Semester Course Syllabus

Course Title	ESTIMATION AND CONTROL	Instructor	TYAN FENG
Course Class	TENXM1A MASTER'S PROGRAM, DEPARTMENT OF AEROSPACE ENGINEERING, 1A	Details	◆ Selective ◆ One Semester ◆ 3 Credits

Departmental Aim of Education

Ⅰ. To lay down a concrete foundation of professional ethics in aerospace and aeronautical engineering, and to cultivate the students' ability in multidisciplinary expertise and continuous learning.

Ⅱ. To setup the students' hands-on ability of and the ability in resolving problem, so that both practical implementations and theories can be emphasized.

Ⅲ. To foster students with diligent and sociable attitude in work, and broadeded international perspective.

Departmental core competences

A. To equip with specific aerospace engineering knowledge and expertise.

B. Be able to master information, capable of utilizing computer to assist solving problems, and possess the ability of conducting learning new knowledge.

C. Be able to design and conduct experiments as well as to analyze, and to solve practical aerospace related engineering problems.

D. Be able to write professional research papers in the field of aerospace engineering.

E. Have a creative thinking, complete analyzing, effective communication, the spirit of teamwork and the ability to solve industrial problems.

Course Introduction	This course covers mathematical approaches to the best possible way of estimating the state of a general system. The goal of the course is to present state estimation theory in the most clear yet rigorous way possible, while providing enough advanced material and references so that the student is prepared to contribute new material to the state of the art. Engineers are usually concerned with implementation, and so the material presented is geared towards discrete time systems.

The Relevance among Teaching Objectives, Objective Levels and Departmental core competences

I.Objective Levels (select applicable ones) :

(i) Cognitive Domain : C1-Remembering, C2-Understanding, C3-Applying, C4-Analyzing, C5-Evaluating, C6-Creating

(ii) Psychomotor Domain : P1-Imitation, P2-Mechanism, P3-Independent Operation, P4-Linked Operation, P5-Automation, P6-Origination

(iii) Affective Domain : A1-Receiving, A2-Responding, A3-Valuing, A4-Organizing, A5-Charaterizing, A6-Implementing

II.The Relevance among Teaching Objectives, Objective Levels and Departmental core competences :

(i) Determine the objective level(s) in any one of the three learning domains (cognitive, psychomotor, and affective) corresponding to the teaching objective. Each objective should correspond to the objective level(s) of ONLY ONE of the three domains.

(ii) If more than one objective levels are applicable for each learning domain, select the highest one only. (For example, if the objective levels for Cognitive Domain include C3,C5,and C6, select C6 only and fill it in the boxes below. The same rule applies to Psychomotor Domain and Affective Domain.)

(iii) Determine the Departmental core competences that correspond to each teaching objective. Each objective may correspond to one or more Departmental core competences at a time. (For example, if one objective corresponds to three Departmental core competences: A,AD, and BEF, list all of the three in the box.)

No.	Teaching Objectives	Relevance	
		Objective Levels	Departmental core competences
1	1. Be familiar with the basic operations of vectors and matrices.. 2. Understand the basic arithmetic of linear system theory. 3. Capable of setting up digital filter (estimator) equations. 4. Understand how to use computer to solve estimation problems in engineering. 5. Develop the ability of analyzing control problems with mathematics.	P3	ABCDE
2	Understand the basic arithmetic of linear system theory.	P3	ABCDE
3	Capable of setting up digital filter (estimator) equations.	P3	ABCDE
4	Understand how to use computer to solve estimation problems in engineering.	P3	ABCDE
5	Develop the ability of analyzing control problems with mathematic tools.	P3	ABCDE

Teaching Objectives, Teaching Methods and Assessment

No.	Teaching Objectives	Teaching Methods	Assessment

1	1. Be familiar with the basic operations of vectors and matrices.. 2. Understand the basic arithmetic of linear system theory. 3. Capable of setting up digital filter (estimator) equations. 4. Understand how to use computer to solve estimation problems in engineering. 5. Develop the ability of analyzing control problems with mathematics.	Lecture, Discussion	Written test
2	Understand the basic arithmetic of linear system theory.	Lecture, Discussion	Written test
3	Capable of setting up digital filter (estimator) equations.	Lecture, Discussion	Written test
4	Understand how to use computer to solve estimation problems in engineering.	Lecture, Discussion	Written test
5	Develop the ability of analyzing control problems with mathematic tools.	Lecture, Discussion	Written test

This course has been designed to cultivate the following essential qualities in TKU students

Essential Qualities of TKU Students	Description
◇ A global perspective	Helping students develop a broader perspective from which to understand international affairs and global development.
◆ Information literacy	Becoming adept at using information technology and learning the proper way to process information.
◆ A vision for the future	Understanding self-growth, social change, and technological development so as to gain the skills necessary to bring about one's future vision.
◇ Moral integrity	Learning how to interact with others, practicing empathy and caring for others, and constructing moral principles with which to solve ethical problems.
◆ Independent thinking	Encouraging students to keenly observe and seek out the source of their problems, and to think logically and critically.
◇ A cheerful attitude and healthy lifestyle	Raising an awareness of the fine balance between one's body and soul and the environment; helping students live a meaningful life.
◇ A spirit of teamwork and dedication	Improving one's ability to communicate and cooperate so as to integrate resources, collaborate with others, and solve problems.
◇ A sense of aesthetic appreciation	Equipping students with the ability to sense and appreciate aesthetic beauty, to express themselves clearly, and to enjoy the creative process.

Course Schedule			
Week	Date	Subject/Topics	Note
1	105/02/15 ~ 105/02/21	Linear systems theory	
2	105/02/22 ~ 105/02/28	Linear systems theory	
3	105/02/29 ~ 105/03/06	Probability theory	
4	105/03/07 ~ 105/03/13	Probability theory	
5	105/03/14 ~ 105/03/20	Least Squares Estimation	
6	105/03/21 ~ 105/03/27	Least Squares Estimation	
7	105/03/28 ~ 105/04/03	Propagation of state and covariances	
8	105/04/04 ~ 105/04/10	Propagation of state and covariances	
9	105/04/11 ~ 105/04/17	The discrete Kalman filter	
10	105/04/18 ~ 105/04/24	Midterm Exam	
11	105/04/25 ~ 105/05/01	The discrete Kalman filter	
12	105/05/02 ~ 105/05/08	The continuous-time Kalman filter	
13	105/05/09 ~ 105/05/15	The continuous-time Kalman filter	
14	105/05/16 ~ 105/05/22	The H-infinity filter	
15	105/05/23 ~ 105/05/29	The H-infinity filter	
16	105/05/30 ~ 105/06/05	Nonlinear Kalman filter	
17	105/06/06 ~ 105/06/12	Nonlinear Kalman filter	
18	105/06/13 ~ 105/06/19	Final Exam	
Requirement		Work Hard.	
Teaching Facility		Computer, Projector	
Textbook(s)		1. Dan Simon, "Optimal State Estimation," Wiley Interscience, 2006 2. R. F. Stengel, "Optimal Control and Estimation," Dover, 1994.	

Reference(s)	1. R. G. Grown and P. Y. C. Hwang, "Introduction to Random Signals and Applied Kalman Filtering with MATLAB Exercises and Solutions," John Wiley, 1997 A. Gilbert, "Applied Optimal Estimation," 1974. G. M. Siouris, "An Engineering Approach to Optimal Control and Estimation Theory," John Wiley & Sons, 1996. F. L. Lewis, "Optimal Estimation with Introduction to Stochastic Control Theory," John Wiley & Sons, 1986.
Number of Assignment(s)	**8** (Filled in by assignment instructor only)
Grading Policy	◆ Attendance： % ◆ Mark of Usual：15.0 % ◆ Midterm Exam： 35.0 % ◆ Final Exam： 50.0 % ◆ Other〈 〉： %
Note	This syllabus may be uploaded at the website of Course Syllabus Management System at http://info.ais.tku.edu.tw/csp or through the link of Course Syllabus Upload posted on the home page of TKU Office of Academic Affairs at http://www.acad.tku.edu.tw/CS/main.php . **※ Unauthorized photocopying is illegal. Using original textbooks is advised. It is a crime to improperly photocopy others' publications.**