Cairo University
Faculty of Engineering

Aerospace Engineering Department

Course Specifications

Program(s) on which this course is given:	M. Sc. – Flight Mechanics and Control Option
Department offering the program:	Aerospace Engineering
Department offering the course:	Aerospace Engineering
Academic Level:	Graduate
Date	
Semester (based on final exam timing)	☐ Fall ☐ Spring

A- Basic Information

1. Title:	Modern Control in Flight Systems			**Code:**	Aero 650			
2. Units/Credit hours per week:	Lectures	2	Tutorial	1	Practical	-	Total	3

B- Professional Information

1. Course description:	The course addresses Modern Control Systems with application to Aerospace Systems and Specifically Aircraft and satellites. The course material includes: 1) Introduction to Modern Control Theory, 2) State Space Approach and its concepts. 3) Relationship between state space and transfer function approaches.4) Modeling and Stability consideration of Flight and Space systems 5) Modern Control System Design Methods- 6) State feedback-pole placement- Output feedback- 7) diagonal dominance design -8) Robust control. 9) Modeling and practical design considerations in Flight and Space control systems. 10) Applications to Satellite Attitude Control. 11) Applications to Aircraft Control Systems.
2. Intended Learning Outcomes of Course (ILOs):	**a) Knowledge and Understanding**
	Modelling of Physical Systems, Linearization. Significance and use of linear theory and the property of linear models. Concept of feedback.
	Properties and features of State Space Modeling. Design of Feedback systems using state space approach.
	b) Intellectual Skills
	Ability to formulate physical systems into mathematical models.
	Understanding the relationship between properties of the designed system and its transient and steady state response. What we actually do by feedback control systems.
	c) Professional and Practical Skills
	Computation and plotting of system transient response-Ability to relate system behavior to the location of its poles and zeros. Understanding similarity transformations between models.
	Ability to design feedback control systems to achieve certain response and stability goals.
	d) General and Transferable Skills
	Matlab (mathematical programming tool) - Simulations- Solution of transient response problems. Matrix algebra- Laplace Transform mathematics and their connection to the physical behavior linear systems.

3. Contents

Topic	Total hours	Lectures hours	Tutorial/ Practical hours
1) Introduction to Modern Control Theory- State Space Approach and its concepts.	6	4	2
2) Relationship between State space and transfer function models.	1 3	2	1

3) Modeling and Stability consideration of Flight and Space systems - Robust control.	6	4	2
4) Modern Control System Design Methods- Characteristics of the open loop and closed loop systems -State feedback-pole placement- Output feedback-	9	6	3
5) Modern Transfer Function Design Approaches- Diagonal Dominance Design	6	4	2
6) Modeling and practical design considerations in Flight and Space control systems	3	2	1
7) Applications to Satellite Attitude Control.	6	4	2
8) Applications to Aircraft Control Systems.	6	4	2
Total Hours	45	30	15
4. Teaching and Learning Methods	Lectures (30)	Practical Training/ Laboratory ( )	Seminar/Workshop (-)
	Class Activity (-)	Case Study (-)	Projects (-)
	E-learning ( )	Assignments /Homework (15)	Other:

5. Student Assessment Methods	
• **Assessment Schedule**	**Week**
-Assessment 1: Class test	5
- Assessment 2: Class assignments (Homework)	Every other week (6 assignments)
-Assessment 3; Project Assignment	N/A
-Assessment 4; Presentations	N/A
-Assessment 5; Midterm Exam	7
-Assessment 6; Final Exam	End of semester
• **Weighting of Assessments**	
-Mid-Term Examination	15%
-Final-term Examination	60%
-Class assignments (Homework)	15%
-Class Test (s)	10%
-Presentation	N/A
-Total	100%

6. List of References

1-Fortmann and Hitz, An Introduction to Linear Control Systems, Published by Marcel Dekker, Inc.

2-Bernard Friedland, Control System Design, An Introduction to State Space Methods, Mc Graw Hill

3-Robert Nelson, Flight Stability and Automatic Control, Mc Graw Hill

7. Facilities Required for Teaching and Learning

Projector

Course Coordinator:	**Prof. Mohamed Bahey Argoun**
Head of Department:	**Prof. Ayman Hamdy Kassem**