AERO 307 – SYSTEM DYNAMICS AND CONTROL

Course Code	Course Name		Semester	
AERO 307	System Dynamics and Control		Fall ☒ Spring ☐ Summer ☐	
Hours			**Credit**	**ECTS**
Theory	**Practice**	**Lab**	3	5
3	0	0		

Course Details	
Department	Aerospace Engineering
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Course Objectives	To provide knowledge on system dynamics, Obtaining the Equations of Motions of combined Mechanical-Electrical-Fluid-Thermal systems. Obtain transfer functions of system. To provide knowledge on control system components To build the understanding of classical control theory and basic controller design methods.
Course Content	Modeling of physical systems and dynamic equations. Transfer functions and block diagrams. Basics of automatic control. Control operations. Frequency and time response. Stability and Routh-Hurwitz criteria. Root locus. Frequency response methods and Bode diagrams.
Course Method/ Techniques	Lecture ☒ Question & Answer ☐ Presentation ☒ Discussion ☐
Prerequisites/ Corequisites	AERO 204 Dynamics
Work Placement(s)	

Textbook/References/Materials

- Ogata, K., "Modern Control Engineering", 5th Edition, Prentice-Hall, 2010.
- Nise, N. S., "Control Systems Engineering", 6th Edition, Addison-Wesley, Menlo Park, CA, 2010.
- Kuo, B. C., Golnaraghi, F., "Automatic Control Systems", 8th Edition, Prentice-Hall, Englewood Cliffs, 2002
- Ercan, Y., Mühendislik Sistemlerinin Modellenmesi ve Dinamiği, 2. Baskı, Literatür Yayınevi, İstanbul, 2003. ISBN: 9789750401077

- Ercan, Y., Klasik ve Modern Kontrol sistemleri Tasarımı, 1. Baskı, Ankara, 2022

Course Category

Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☐
Engineering Design	☒		Health	☐
Social Sciences	☐		Profession	☐

Weekly Schedule

No	Topics	Materials/Notes
1	Introduction to System Dynamics and Control Systems	
2	Mathematical modelling of physical systems and dynamic equations (Mechanical, Hydrolic, Electrical, Thermal Systems)	
3	Mathematical modelling of physical systems and dynamic equations (Mechanical, Hydrolic, Electrical, Thermal Systems)	
4	Mathematical modelling of physical systems and dynamic equations (Mechanical, Hydrolic, Electrical, Thermal Systems)	
5	Laplace Transform Transfer functions of multiple input and multiple output systems.	
6	Block diagrams. Obtaining transfer functions from block diagrams Structure of feedback control systems. Desired characteristics of control systems	
7	Control System Components, Stability of control systems. Stability and system poles. Relative stability and stability margin.	
8	Midterm Exam	
9	Transient response specifications and their use in analysis and design of 2nd order systems.	
10	Steady state response. Steady state error and error constants.	
11	Controller and control actions. Proportional (P), integral (I), derivative (D) control actions. P, I, P+D, P+I and P+I+D control. Industrial controllers	
12	Root locus method. Examples of root locus diagrams method.	
13	Frequency response method. Graphical representations of frequency response.	
14	Control system design by root locus method and frequency response method	
15	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance	14	
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework	4	20%
Presentation / Seminar		
Project		
Report		
Seminar		
Midterm Exam	1	30%
Final Exam	1	50%
	Total	**100%**
Contribution of Semester Studies and Midterm to Success Grade		50%
Contribution of End of Semester Studies to Success Grade		50%
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	14	3	42
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time			
Quiz/Studio/Criticize			
Homework	4	10	40
Presentation / Seminar			
Project			
Report			
Midterm Exam and Preparation for Midterm	1	20	20
Final Exam and Preparation for Final Exam	1	20	20
Total Workload			**122**
Total Workload / 25			**4.88**
ECTS Credit			**5**

Course Learning Outcomes	
No	**Outcome**
L1	Modelling to combined physical system
L2	Devivating the mathematical model (differential Equation) of dynamic system according to IO relation
L3	Applying Laplace transform
L4	Obtaning to transfer function (TF)
L5	Using the Control System Toolbox software
L6	Represent system in different style such as Block diagram, diffEq, TF, state space
L7	Analyse of the stability of a system by investigating eigen values
L8	Understanding the component of Control System and obtaining the mathematical model of component
L9	Learn the performance metrics of dynamic systems by investigating the transient response and steady state response
L10	Principles of control action: on-off control, PID control
L11	Learn drawing of Root Locus and meaning of it
L12	Control System Desing understanding by using Root Locus Methods in term of performance metrics relation
L13	Learn drawing of Bode Plot and meaning of it
L14	Control System Desing understanding by using FRF

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L2	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L3	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L4	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L5	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L6	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L7	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L8	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L9	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L10	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L11	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L12	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L13	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
L14	5	5	5	5	2	5	4	3	2	1	3					40/55; 72,7%
															Total	560/770; 72,7%