COURSE SYLLABUS

FACULTY / GRADUATE SCHOOL	FACULTY OF MECHANICAL ENGINEERING
DEPARTMENT / PROGRAMME	MECHATRONICS ENGINEERING
TITLE OF COURSE	Fundamentals of Electric Motor Control
CODE	MTH4402
LOCAL CREDIT	3
ECTS	5
LECTURE HOUR / WEEK	3
PRACTICAL HOUR / WEEK	0
LABORATORY HOUR / WEEK	0
PREREQUISITE	-
SEMESTER	Spring
COURSE LANGUAGE	English
LEVEL OF COURSE	Undergraduate
COURSE TYPE	Elective (MES-A)
COURSE CATEGORY	Major Area Course
MODE OF DELIVERY	Online
OWNER ACADEMIC UNIT	Mechatronics Engineering
COURSE COORDINATOR	Assoc. Prof. Dr. Hüseyin Ayhan Yavaşoğlu
INSTRUCTOR(S)	Dr. Fatih Eroğlu
ASSISTANT(S)	Res. Assis. Berkay Gürkan
COURSE OBJECTIVES	1. To teach the mathematical modeling and operating principles of electric motors used in electric vehicles. 2. To teach the basic methods used in torque and speed control of electric motors.
COURSE CONTENT	Introduction to electric motors; DC motor modeling and control; AC asynchronous motor (induction motor) fundamentals; AC synchronous motor fundamentals; AC asynchronous motor (induction motor) mathematical modeling; Permanent magnet AC synchronous motor mathematical modeling; Reference axis transformations; AC motor vector control; AC motor current regulators; PWM-based DC-AC converter fundamentals – carrier-based PWM methods; PWM-based DC-AC converter fundamentals – overmodulation methods; Flux attenuation methods in AC asynchronous motors; Flux attenuation methods in AC synchronous motors; Speed estimation and sensorless control in AC motors.
RECOMMENDED OR REQUIRED READING	1. Sul, Seung-Ki (2011) Control of Electric Machine Drive Systems. Institute of Electrical and Electronics Engineers, Inc. 2. Kim, Sang-Hoon (2017) Electric Motor Control: DC, AC, and BLDC Motors, Elsevier Inc.

	3. Chapman, Stephen J. (2012) Electric Machinery Fundamentals. New York:McGraw-Hill.
Course Learning Outcomes	Students who successfully complete this course will be able to: 1. Gain general knowledge about the general structure of electric motors used in electric vehicles. 2. Learn about the mathematical modeling of electric motors. 3. Learn about torque and speed control methods of electric motors. 4. Learn about methods that convert electrical energy from direct current to alternating current.

EVALUATION SYSTEM

Activities	Number	Percentage of Grade
Attendance/Participation		
Laboratory		
Application		
Field Work		
Special Course Internship (Work Placement)		
Quizzes/Studio Critics		
Homework Assignments	2	20
Presentations/Jury		
Project		
Seminar/Workshop		
Mid-Terms	1	40
Final	1	40
Percentage of In-Term Studies		60
Percentage of Final Examination		40
TOTAL		100

WEEKLY SUBJECTS AND RELATED PREPARATION STUDIES

WEEKS	COURSE OUTLINE	Related Preparation
1	Introduction to electric motors	Introduction to electric motors
2	DC motor modeling and control	Basic structure of a DC motor, DC motor control.
3	Basics of AC asynchronous motors (induction motors)	Basic structure of an AC asynchronous motor.
4	AC senkron motor temelleri	AC synchronous motor mathematical modeling
5	AC asynchronous motor (induction motor) mathematical modeling	Mathematical modeling of asynchronous motors
6	Mathematical modeling of permanent magnet AC synchronous motors	Mathematical modeling of permanent magnet AC synchronous motors
7	Reference Frame Transformations	Transformation from stationary reference frame to synchronous reference frame,
8	Midterm 1	
9	Vector control in AC motors	Fundamentals of vector control in AC motors.
10	AC motor current regulators	Current regulation methods in AC motors.

11	**Fundamentals of PWM-based DC-AC converters – carrier-based PWM methods**	PWM applications at high switching frequencies
12	**Fundamentals of PWM-based DC-AC converters – overmodulation methods**	Overmodulation methods in DC-AC converters
13	**Field weakening in AC asynchronous motors**	Operating conditions in the field weakening region of AC asynchronous motors
14	**Field weakening in AC synchronous motors**	Operating conditions in the field weakening region of AC synchronous motors
15	**Speed estimation and sensorless control in AC motors**	Speed estimation methods used in AC motors and the fundamentals of sensorless control.
16	**Industrial practical applications and common issues**	Industrial practical applications and common issues.

ECTS WORKLOAD TABLE

Activities	Number	Duration (Hour)	Total Workload
Course Hours	14	3	42
Laboratory			
Application			
Field Work			
Study Hours Out of Class	14	2	28
Special Course Internship (Work Placement)			
Homework Assignments			
Quizzes/Studio Critics	2	14	28
Project			
Presentations / Seminar			
Mid-Terms (Examination Duration + Examination Prep. Duration)	1	21	21
Final (Examination Duration + Examination Prep. Duration)	1	24	24
		Total Workload :	143
		Total Workload / 30(h) :	4.766
		ECTS Credit :	5