MODELING AND CONTROL OF PEM FUEL CELL

1	Course Title:	MODELING AND CONTROL OF PEM FUEL CELL	
2	Course Code:	OHE5017	
3	Type of Course:	Optional	
4	Level of Course:	Second Cycle	
5	Year of Study:	1	
6	Semester:	1	
7	ECTS Credits Allocated:	6.00	
8	Theoretical (hour/week):	3.00	
9	Practice (hour/week):	0.00	
10	Laboratory (hour/week):	0	
11	Prerequisites:	None	
12	Language:	Turkish	
13	Mode of Delivery:	Face to face	
14	Course Coordinator:	Prof. Dr. ALİ SÜRMEN	
15	Course Lecturers:	Araş. Gör. Fırat Işıklı	
16	Contact information of the Course Coordinator:	Prof. Dr. Ali Sürmen Bursa Uludağ Üniversitesi, Mühendislik Fakültesi, Otomotiv Mühendisliği Bölümü Öğretim Üyesi 16059 Görükle Kampüsü - BURSA Tel: +90.224.294 1965 +90.532.334 6112	
17	Website:		
18	Objective of the Course:	The most suitable PEM Fuel Cell for automotive applications will be modeled in 1-D. Students can calculate the performance of the fuel cell by making the one-dimensional modeling of all the sub-elements on the system separately.	
19	Contribution of the Course to Professional Development:	Fuel cells are increasingly taking place in automotive applications. With each passing day, more and more public and private institutions have started to deal with the different dimensions of the automotive applications of the fuel cell. A student who takes this course comes to a level where he can make a significant contribution to the institutions he will work in, by having knowledge in other dimensions as well as the general analysis of the PEM fuel cell in his professional life.	
20	Learning Outcomes:		
		1	Students know all the components and functions of the PEM (Polymer Electrolyte Membrane) fuel cell system and the fuel cell itself.
		2	Students learn the working principle of PEM fuel cell.
		3	Students learn the performance parameters of the PEM fuel cell system.
		4	Students will have the theoretical knowledge and modeling principles related to the operation of the subsystems of the PEM fuel cell.
		5	Students understand the operating constraints of the PEM fuel system and the parametric limits of the modeling.
		6	Students can communicate orally and in writing in at least European Language with what they have learned in the course and in the literature.

	7	They have the ability to use information and communication technologies at a certain level, together with the computer software required by PEM fuel cells.
	8	Students can appreciate the scientific position of PEM fuel cells in power systems with the knowledge they have acquired and have the ability to transfer information to third parties on these issues.
	9	Students will be able to understand the social and environmental impacts of using PEM fuel cells as a power system.
	10	Students come to a certain level in all kinds of literature research, data compilation, comparison and transfer to society about Electric and Hybrid Vehicles, especially PEM fuel cells.

21	Course Content:

Course Content:

Week	Theoretical	Practice
1	Fuel cells and their usage area	
2	Explaining the PEM fuel cell and its components	
3	Modeling of the PEM fuel cell compressor	
4	Modeling of the PEM fuel cell compressor	
5	Modeling the air cooler and humidifier in the supply manifold	
6	Mathematical expression of pressure, flow and mole amounts of the fluid entering the anode flow channel	
9	Creation of the stack voltage model	
11	Modeling of the DC-DC power converter	
12	Modeling of the DC-DC power converter regulating the fuel cell output voltage	
	model	
	Materials.	

Activites	Number	Duration (hour)	Total Work Load (hour)
Theoretical	14	3.00	42.00
Practicals/Labs	0	0.00	0.00
Self study and preperation	10	6.00	60.00
Homeworks	4	15.00	60.00
Projects	0	0.00	0.00
Field Studies	0	0.00	0.00
Midterm exams	0	0.00	0.00
Others	0	0.00	0.00
Final Exams	1	18.00	18.00
Total Work Load			180.00
Total work load/ 30 hr			6.00
ECTS Credit of the Course			6.00

Systems and Fuel Processors. Doktora Tezi, The University of Michigan, Mechanical Engineering, Michigan.

Kaya, D., Öztürk, H., Kayfeci, M. 2017. Hidrojen ve Yakıt Pili Teknolojisi. Umuttepe Yayınları, Kocaeli, 216s.

Ehsani, M., Gao, Y., Gay, S. E., Emadi, A. 2005. Modern Electric, Hybrid Electric & Fuel Cell Vehicles. CRC Press, USA, 395s.

Borat, O. 1983. Yanma Stokiyometrisi. İTÜ Makina Fakültesi Ofset Atölyesi, İstanbul, 117s.

23	Assesment

TERM LEARNING ACTIVITIES	NUMBER	WEIGHT
Midterm Exam	0	0.00

Quiz	0	0.00
Home work-project	4	50.00
Final Exam	1	50.00
Total	5	100.00
Contribution of Term (Year) Learning Activities to Success Grade		50.00
Contribution of Final Exam to Success Grade		50.00
Total		100.00
Measurement and Evaluation Techniques Used in the Course		Measurement and evaluation are performed according to the Rules & Regulations of Bursa Uludağ University on Undergraduate Education.

24 ECTS / WORK LOAD TABLE

25 CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS

	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16
ÖK1	0	2	0	0	3	3	0	0	0	0	0	0	0	0	0	0
ÖK2	1	2	0	0	3	3	0	0	0	0	0	0	0	0	0	0
ÖK3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK4	0	0	2	1	0	0	2	0	0	3	0	0	3	0	0	2
ÖK5	0	0	3	2	0	0	2	0	1	4	0	0	4	0	0	3
ÖK6	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	0
ÖK7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK8	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0
ÖK9	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
ÖK10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

LO: Learning Objectives PQ: Program Qualifications

Contribution Level:	1 very low	2 low	3 Medium	4 High	5 Very High