FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Napędy elektryczne pojazdów**
Name in English:	**Electrical drives vehicles**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	**Automation of Machines, Vehicles and Apparatus**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**optional**
Subject code:	**APR013229**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30			15	
Number of hours of total student workload (CNPS):	60			30	
Form of crediting:	examination			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	2			1	
including number of ECTS points for practical (P) classes :				1	
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40			0.70	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has an advanced knowledge of the topology of power electronic systems. He knows the mathematical description of the electronics circuits. Understands methods of modulation in power converters systems
2. He has knowledge of modern electrical drives control structures of various types of motors (AC, DC, PMSM)
3. He has knowledge of advanced methods of modeling, design and testing of control systems
4. He is able to plan and carry out the study of complex electrical drive systems with AC motors and DC. Able to analyze complex systems, electric drives, plan their testing process, can formulat and test hypotheses
5. He knows the rules of group work and direct a small team taking responsibility for the results of his work

SUBJECT OBJECTIVES

C1. Understanding students with the knowledge connected with the electric drives applied in electric vehicles
C2. Informing students about the safety problem
C3. The acquisition of practical knowledge and skills necessary to build a modern drive systems for electric vehicles

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	He has knowledge in the field of power electronics and control systems of modern electrical drives
PEU_W02	He has knowledge on developments in the field of electric drive vehicles
PEU_W03	He has theoretically founded knowledge about the safety systems in automotive

relating to skills:

PEU_U01	He is able to design modern control systems for complex algorithms to analyze the motion, can think creatively and communicate knowledge of the basics of electric vehicle systems
PEU_U02	He can design automatic control systems, electronic components, including propulsion systems for selected criteria of economic performance and, if necessary, adapt existing or develop new design methods and tools Computer-aided design (CAD)

relating to social competences:

PEU_K01	He can think and act in a creative and enterprising

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction, credit requirements. Fundamentals drive systems used in electric vehicles. The theory of motion control - an analysis of the suitability of the electric drive motor vehicles. Effect of mechanical connections to the drive.	2
Lec 2	Fundamentals drive systems used in electric vehicles. The theory of motion control - an analysis of the suitability of the electric drive motor vehicles. Effect of mechanical connections to the drive	2
Lec 3	Fundamentals drive systems used in electric vehicles. The theory of motion control - an analysis of the suitability of the electric drive motor vehicles. Effect of mechanical connections to the drive	2
Lec 4	Electric drive systems and control. Examples of solutions design and performance characteristics of electric vehicles.	2
Lec 5	Analysis of the active-controlled rectifier - possible use in the electrical drives and traction system	2
Lec 6	Electrical drives – control methods. Influence of the chosen sensors on their work. The issue of safety drives.	2
Lec 7	Electrical drives – control methods. Influence of the chosen sensors on their work. The issue of safety drives.	2
Lec 8	Traction drive system. Advantages and disadvantages of the electrical drives	2
Lec 9	Traction drive system. Advantages and disadvantages of the electrical drives	2
Lec 10	Electrical vehicles – state of the art	2
Lec 11	Electrical vehicles – state of the art	2
Lec 12	Energy sources in electrical vehicles	2
Lec 13	Hybrid vehicles. Construction, purpose of use and types of hybrids	2
Lec 14	Diesel-electric hybrid vehicles. Examples of design solutions hybrid cars	2
Lec 15	Development trends of energy technologies in transport. Assessment	2
	Total hours:	**30**

Form of classes - project		**Number of hours:**
Proj 1	Presentation of the Rules of Procedure Health and Safety Laboratory. Establish rules for passing. General knowledge of the workplace. Discussion of the rules for the implementation of projects	2
Proj 2	Realisation of the project connected with control algorithm for electric vehicle.	11
Proj 3	Completion	2
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture with audio-visual technology, multimedia presentations, transparencies
N2. presentation of the project, consultations, etc.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	exam
F2(W)	PEU_W01 PEU_W02 PEU_W03	presence at the lecture
P(W)	P=0.9*F1+0.1*F2	
F1(P)	PEU_U01 PEU_U02 PEU_K01	presence at the lecture
F2(P)	PEU_U01 PEU_U02 PEU_K01	project realisation
F3(P)	PEU_U01 PEU_U02 PEU_K01	activity
P(P)	P=0.1*F1+0.7*F2+0.2*F3	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Koczara, Włodzimierz, Wprowadzenie do napędu elektrycznego, Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2012
[2] Merkisz J., Pielecha I.: Alternatywne napędy pojazdów. Wydawnictwo Politechniki Poznańskiej. Poznań 2006.
[3] Michałowski K., Ocioszyński J., Pojazdy samochodowe o napędzie elektrycznym i hybrydowym. WKiŁ, Warszawa, 1989.
[4] Drozdowski P., Wprowadzenie do napędów elektrycznych, Skrypt Politechniki Krakowskiej, Kraków 1998.
[5] Bisztyga K., Sterowanie i regulacja silników elektrycznych, Warszawa, WNT 1989
[6] E. Gmurczyk, A. Kundera, M. Niewiadomski, T. Płatek, Nowoczesne asynchroniczne napędy pojazdów trakcyjnych, Wiadomości Elektrotechniczne - 2006).

SECONDARY LITERATURE:

[1] Orłowska-Kowalska, Teresa, Bezczujnikowe układy napędowe z silnikami indukcyjnymi, Wrocław : Oficyna Wydawnicza Politechniki Wrocławskiej, 2003
[2] Dębicki M.: „Teoria samochodu. Teoria napędu". WNT 1969.
[3] Szumanowski A.: „Czas energii". WKiŁ 1988
[4] Mitschke M.: „Dynamika samochodu. Napęd i hamowanie". WKiŁ 1987
[5] Szydelski Z.: „Sprzęgła, hamulce i przekładnie hydrokinetyczne". WKiŁ 1981
[6] Szklarski L., K. Jaracz, K. Viteček: „Optymalizacja układów napędowych". PWN 1989
[7] Erik Schaltz (2011). Electrical Vehicle Design and Modeling, Electric Vehicles - Modelling and Simulations, Dr. Seref Soylu (Ed.), ISBN: 978-953-307-477-1, InTech, DOI: 10.5772/20271. Available from: http://www.intechopen.com/books/electric-vehicles-modelling-and-simulations/electrical-vehicle-design-and-modeling
[8] Lorenzo Galati, Giordano and Luca Reggiani,Vehicular Technologies - Deployment and Applications, Publisher: InTech, Chapters published February 13, 2013 under CC BY 3.0 license, DOI: 10.5772/46112 http://www.intechopen.com/books/vehicular-technologies-deployment-and-applications

SUBJECT SUPERVISOR

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