

Specialties on  
"Electric and Hybrid Vehicle  
Engineering" field of study in English

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# Specialty modules in course elements library – 6th semester

Year	3							Semester 6
Nr	Subject	Institute	Full time study				ECTS	Method of assessment
			Lecture	Excercise	Laboratory	Project		
			1	Physics III	IF	2		
2	Fundamentals of technical Diagnostics	IP/ZLM	1	0	1	0	2	E/Z1
3	Smart Grid / Introduction to Robotics	WE / IMRC	1	0	0	0	1	Z2
2	Fundamentals of Finite Element Method	IPBM	1	0	1	0	2	Z2/Z1
5	Project on Electric and Hybrid Drives	IMRC	2	0	0	2	4	E/Z1
6	Image Processing and Analysis	IP/ZLM	1	0	2	0	3	Z2/Z1
7	Mechatronics Systems Design	IP/ZLM	0	0	0	2	2	Z1
8	Specialization module 1	IP/IMRC	2	0	1	0	4	E/Z1
9	Specialization module 2	IP/IMRC	2	0	1	0	4	E/Z1
10	Specialization module 3	IP/IMRC	1	0	1	0	2	Z2/Z1
11	Interim Project	IP/IMRC	0	0	0	5	4	P
12	Apprenticeship		4 weeks				4 <sup>x</sup>	
			13	0	7	9	30	
			29					

# Specialty modules in course elements library – 7th semester

Year	4						Semester 7	
Nr	Subject	Institute	Ful time study				ECTS	Method of assessment
			Lecture	Excercise	Laboratory	Project		
			1	Elective module (HES)	WAI NS	2		
2	Elective module (HES)	WAI NS/Si MR	2	0	0	0	2	Z2
3	Vehicle Recycling	IPBM	2	0	0	0	2	Z2
4	Specialization module 4	IP/IMRC	2	0	0	0	3	Z2
5	Specialization module 5	IP/IMRC	1	0	1	0	3	Z2/Z1
6	Specialization module 6	IP/IMRC	2	0	0	0	2	Z2
7	Diploma seminar	IP/IMRC/I PBM	0	1	0	0	1	Z1
8	Thesis	IP/IMRC	0	0	0	10	15	P
			11	1	1	10	30	
			23					

The following specialties are offered for the first-cycle (BSc) studies in English:

- Autonomous Vehicles
- Ecological Vehicles
  
- Unconventional Vehicles

In case of a large number of students (at least two dean groups) first two specialties will be launched.

In the case of a small number of students (one dean's group) only one specialty will be launched (third specialty - mix of the first two specialties)

## Specialty "Ecological Vehicles"

### **6th Semester**

1. (2Lect/1Lab) – Electric and Hybrid Vehicles Engineering (IPiMR/ZNW)
2. (2Lect/1Lab) – Advanced control of electric and hybrid drives (IPiMR/ZNW)
3. (1Lect/1Lab) – Electrically controlled Continuously Variable Transmission (IPiMR/ZNW)

### **7th Semester**

4. (2Lect) – Operational infrastructure of electric and hybrid vehicles (IPiMR/ZNW)
5. (1Lect/1Lab) – Diagnosis of electric and hybrid vehicles (IP)
6. (2Lect) – Ultralight vehicle bodies (IP)

## Specialty "Autonomous Vehicles"

### **6th Semester**

1. (2Lect/1Lab) – Navigation of autonomous vehicles (IP/ZLM)
2. (2Lect/1Lab) – Energy harvesting in vehicles (IP)
3. (1Lect/1Lab) – Vision systems for mobile robots (WM)

### **7th Semester**

4. (2Lect) – Support and energy-intensive structures in vehicles (IP)
5. (1Lect/1Lab) – Vehicle Informatic Systems (IP/ZLM)
6. (2Lect) – Reliability and safety of mechatronic systems (IP/ZLM)

## Specialty "Unconventional Vehicles"

### **6th Semester**

1. (2Lect/1Lab) – Electric and Hybrid Vehicles Engineering (IMRC)
2. (2Lect/1Lab) – Navigation of autonomous vehicles (IP/ZLM)
3. (1Lect/1Lab) – Electrically controlled Continuously Variable Transmission (IMRC)

### **7th Semester**

4. (2Lect) – Support and energy-intensive structures in vehicles (IP)
5. (1Lect/1Lab) – Vehicle Informatic Systems (IP/ZLM)
6. (2Lect) – Ultralight vehicle bodies (IP)

Modules in specialty „Ecological Vehicles“:

## Electric and Hybrid Vehicles Engineering

/ dr hab. Yuhua Chang /dr Zhiyin Liu

- Overview of structures and hybrid electric drives. Characteristics, advantages, disadvantages.
- Components of multisource drives.
- Control of multisource drives.
- The design of electric and hybrid vehicles.
- Design rules for electric and hybrid vehicles.
- Determination of parameters of components of multisource drives.
- Selection of drive structure to the requirements of the vehicle.
- Primary and secondary power sources - an overview of the technology.
- Electrochemical batteries - different technologies, acid, gel, NiCd, NiMH, Lilon, bipolar, characteristics, emf, internal resistance, charging characteristics, SOC, SOH, load and battery life, active and passive systems for load leveling, charging systems and battery replacement in vehicles.
- Monitoring and measurement data acquisition - terminology, systems architecture, the types of signals and transducers.

## Advanced Control of Electric and Hybrid Power Trains

Dr Paweł Roszczyk

- Control of energy flow and power distribution in series and parallel hybrid drive.
- The conception of master controller for electric and hybrid drive. Control strategy.
- The influence of drive control strategy on its components efficiency.
- Control methods of electric machines in four quadrants of torque – speed coordinates.
- Control methods of speed end load torque of internal combustion engine.
- The mechanical drive components - clutches, brakes and multi-gear gearboxes - the influence on drive structure and control aimed to energy saving.
- The nonlinearity problems in control of drive components.
- Systems monitoring for drive system components. Definition and indication of the battery State of Charge.
- The active and passive balancing method of the supercapacitors and batteries cells voltage.
- The fuel cell output voltage control - the adjustment of relation between hydrogen and oxygen.
- Electromechanical differential - design and modeling.
- Main control system implementation in d'Space - rapid prototyping platform.
- Fuzzy-logic control.
- Kalman filter for approximation the state of the drive components (for linear and non-linear systems).

## Electrically Controlled CVTs

Dr Arkadiusz Hajduga

- The role of mechanical gears in the drive.
- The impact of the use of mechanical transmission on energy parameters of the drive system.
- Continuous Variable Transmission - definition, the idea of action and the basic characteristics in the electric and hybrid power train.
- Types of CVTs.
- Materials used in the construction of the CVTs,
- The method of selection of the range of gears in vehicles with electric and hybrid power trains
- Control methods of change of the ratio of CVT
- Control algorithm of ratio change in electric and hybrid power train - minimization of energy consumption.
- Precise control of the CVT ratio - stepper motors.
- The role and work of the stepper motor -reducer assembly in electric or hybrid power train control system - executive signals and feedbacks analysis to the correct operation of the drive - the appointment of the CVT control.
- The real arrangement of the CVT ratio change by a stepper motor.
- Control system of stepper motor.
- The planetary gear with two degrees of freedom as an example of an electrically controlled CVT - implementation of shifting.

## **Infrastructure Operating Electric and Hybrid Vehicles**

Dr Adrian Chmielewski

## **Diagnosis of Electric and Hybrid Vehicles**

Dr Przemysław Szulim/dr Krzysztof Więclawski

## **Ultralight Vehicle Bodies**

Dr Jarosław Seńko

Detailed scopes of all modules are here:

Faculty of Automotive and Construction Machinery Engineering → Studies → Fields of Study →  
Electric and Hybrid Vehicle Engineering

Students choose a specialty, but the dean decides about admission to the specialty, based on the average grades of students

(the number of students in specialties should be roughly equal)