DESCRIPTION OF THE COURSES

- Course code: **ARR3214**
- Course title: **ELECTRICAL DRIVES FOR ROBOTS**
- Language of the lecturer: POLISH

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*		*1*		
*Number of hours/semester**	*30*		*15*		
Form of the course completion	*E*		*credit*		
ECTS credits	*3*		*1*		
Total Student's Workload	*90*		*30*		

- Level of the course (basic/~~advanced)~~:
- Prerequisites: Basics of robotics, Electrical drives
- Name, first name and degree of the lecturer/supervisor: **Teresa Orłowska-Kowalska, prof. dr hab. inż., Krzysztof Pieńkowski, dr hab. inż.**
- Names, first names and degrees of the team's members: **Czesław Kowalski, dr hab. inż., Krzysztof Dyrcz, dr inż., Marcin Pawlak, dr inż., Mateusz Dybkowski, mgr inż.**
- Year:....III..... Semester:.....6.....
- Type of the course (obligatory/~~optional)~~:
- Aims of the course (effects of the course): *learn of basic problems connected with electrical, hydraulic and pneumatic drive system for manipulators and industrial robots.*
- Form of the teaching (traditional/~~e-learning~~):
- Course description: Classification of drives in tool machines, robots and manipulators. Basic requirements and parameters of servodrives. Electrical motors used in servodrives. Design problems of electrical drives: motors, gears, power electronic converters, controllers, measurement systems. Speed and position controllers; parameter adjustment, dynamical properties of speed and position control loops. Servodrives with DC and AC motors; control methods and structures. Hydraulic and pneumatic drives – basics. Actuators and motors. Valves for pressure and flow control. Control in pneumatic and hydraulic systems. Electro-hydraulic amplifiers and servomechanisms. Application in robot drives. Technical solutions of servodrives, development trends. In laboratory exercises models and industrial solutions of servodrives are demonstrated and tested.

- Lecture:

Particular lectures contents	*Number of hours*
1. *Classification of drives in tool machines, robots and manipulators. Basic requirements and parameters of servodrives.*	*2*
2. *Electrical motors used in servodrives; permanent magnet DC and AC motors, step motors; main parameters and requirements.*	*2*
3. *Design problems of electrical drives: motors, gears, power electronic*	*2*

converters, controllers, measurement systems.	
4. Speed and position controllers; parameter adjustment, dynamical properties of speed and position control loops.	*2*
5. Servodrives with DC motors; control methods and structures, control in cascade structure, static and dynamical properties.	*2*
6. Servodrives with induction motors: vector control methods and structures,	*2*
7. Servodrives with permanent magnet DC and AC motors, vector control of the PMSM motors.	*2*
8. Servodrives with step motors; control methods and structures.	*2*
9. Problems of sensorless drives; methods for speed and position estimation; state variable estimators and observers.	*2*
10. Technical solutions of servodrives, development trends.	*2*
11. Hydraulic and pneumatic drives – basics.	*2*
12. Actuators and motors.	*2*
13. Valves for pressure and flow control.	*2*
14. Control in pneumatic and hydraulic systems.	*2*
15. Electro-hydraulic amplifiers and servomechanisms. Application in robot drives.	*2*

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:

1. Introduction to laboratory equipment
2. Linear positioning system with DC motor
3. Positioning system with DC motor in the IRb6 robot.
4. Linear positioning system with step motor.
5. Multiaxis positioning system of the Cartesian robot.
6. Linear positioning system with permanent magnet synchronous motor (PMSM).
7. Multiaxis positioning system of the SCARA robot.
8. Multiaxis positioning system of the arm robot.

- Project – the contents:
- Basic literature:

1. Kaczmarek T., Napęd elektryczny robotów, Wydawnictwo Polit. Poznańskiej, 1996
2. Wrotny L.T., Robotyka i elastycznie zautomatyzowana produkcja, T.2, Napędy robotów przemysłowych, T.5, Modelowanie zrobotyzowanych i elastycznych systemów produkcyjnych, WNT, 1991
3. Pritschow G., Technika sterowania obrabiarkami i robotami przemysłowymi, Oficyna Wyd. P.Wr. 1995

- Additional literature:

1. P.Kaźmierkowski, H.Tunia, Automatyka napędu przekształtnikowego, PWN, 1987
2. T. Orłowska-Kowalska, Bezczujnikowe sterowanie układów napędowych z silnikami indukcyjnymi, Oficyna Wyd. P.Wr. 2003
3. K. Zawirski, Sterowanie silnikiem synchronicznym o magnesach trwałych, Wyd. P. Poznańskiej, 2005

- Conditions of the course acceptance/credition:
  Lecture– egzam, Laboratory – presence and performing of all exercises, preparing reports.

* - depending on a system of studies