DESCRIPTION OF THE COURSES

- Course code: **ARR3207**
- Course title: **CONTROLLED ELECTRICAL DRIVES**
- Language of the lecturer: Polish

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*		*2*		
*Number of hours/semester**	*30*		*30*		
Form of the course completion	*Exam*		*Credit*		
ECTS credits	*4*		*2*		
Total Student's Workload	*120*		*60*		

- Level of the course (~~basic~~/advanced~~)~~):
- Prerequisites: Control theory, Electrical drives, Power electronics
- Name, first name and degree of the lecturer/supervisor: **Teresa Orłowska-Kowalska, prof. dr hab. inż.**
- Names, first names and degrees of the team's members: **Adam Zalas, dr inż.; Krzysztof Dyrcz, dr inż.; Krzysztof Szabat, dr inż.**
- Year:....I..... Semester:.....1.....
- Type of the course (obligatory/~~optional)~~:
- Aims of the course (effects of the course): *learn of modern control methods DC and AC motor drives; problems of sensorless drives, nonlinear controllers applications in electrical drives.*
- Form of the teaching (traditional/~~e-learning~~):
- Course description:

Basics of control system synthesis problems for electrical drives. Control quality indexes for electrical motors, static and dynamical optimization of electrical drives. Torque control structures; adjustment criteria for linear controllers. Torque and speed control structures of electrical drives; examples of technical realizations in DC and AC drives. Scalar and vector control methods in AC drives with induction and permanent magnet synchronous motors. Field oriented control and direct torque control of AC motors. State variables estimation for AC motor drives. Electrical drives with microprocessor control. Artificial intelligence methods in electrical drives. In laboratory exercises models and industrial solutions of automated electrical drives are demonstrated and tested.

- Lecture:

Particular lectures contents	*Number of hours*
1. *Basics of control system synthesis problems for electrical drives; control quality indexes for electrical motors*	*2*
2. Static and dynamical optimization for electric motor drives; torque control structures of electrical drives.	*2*
3. Adjustment criteria for linear controllers, integral criteria, modulus and	*2*

symmetry criteria.	
4. Static optimization conditions for DC motor; constant and variable flux control, dynamical properties for constant and variable excitation flux.	*2*
5. Speed control methods of converter-fed DC motor drives: series and parallel speed control structure, direct speed control.	*4*
6. Influence of static rectifier to the motor dynamical performance; adaptive control.	*2*
7. Induction motor – mathematical model using vector representation, state equations.	*2*
8. Frequency controlled induction motor drives – conditions of static optimization. Torque control methods of the induction motor.	*2*
9. Methods and structures of vector control in induction motor drives (field oriented control methods, direct torque control method); practical realization issues	*4*
10. Scalar control methods with constant flux and slip.	*2*
11. Frequency control methods for permanent magnet synchronous motors. Application of AC motors in servodrives.	*2*
12. Sensorless drives, state variables estimation methods and structures for AC motor drives.	*2*
13. Electrical drives with microprocessor control. Artificial intelligence methods in electrical drive.	*2*

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
  1. Forming of static and dynamical properties of the rectifier-fed DC motor drive.
  2. Forming of dynamical properties of the six pulse bidirectional rectifier-fed DC motor drive.
  3. Testing of the control system of the thyristor circuit.
  4. Speed stabilization system for the chopper-fed disc motor.
  5. Cascade control structure of the DC drive system – part 1 and 2.
  6. Adaptive control of the electrical drive.
  7. Control of the DC drive system with elastic joint.
  8. Field-oriented control of the induction motor drive system – part 1 and 2.
  9. DTC control of the induction motor drive.
  10. Vector control of the PMSM motor drive system – part 1 and 2.
- Project – the contents:
- Basic literature:
  1. Orlowska-Kowalska T., *Bezczujnikowe układy napędowe z silnikami indukcyjnymi*, Oficyna Wydawnicza P.Wr., Wrocław, 2003
  2. Kazimierkowski M.P., Tunia H., *Automatyka napędu przekształtnikowego*, PWN, 1987
- Additional literature:
  1. W.Leonhard, *Control of Electrical Drives*, Springer Verlag, 1990
  2. P.Vas, *Sensorless Vector and Direct Torque Control*, Oxford University Press, 1998
  3. J.M.D.Murphy, F.G.Turnbull, *Power Electronic Control of AC Drives*, Pergamon Press, Oxford, 1988
- Conditions of the course acceptance/credition:
  Lecture – pass of the written test, exam; Laboratory – presence and performing of all exercises, preparing reports.

***** - depending on a system of studies