

DESCRIPTION OF THE COURSES

- Course code: **ARR2201**
- Course title: **Power system protection - fundamentals**
- Language of the lecturer: **polish, english**

<i>Course form</i>	<i>Lecture</i>	<i>Classes</i>	<i>Laboratory</i>	<i>Project</i>	<i>Seminar</i>
<i>Number of hours/week*</i>	2		1	1	
<i>Number of hours/semester*</i>	30		15	15	
<i>Form of the course completion</i>	Exam		Completion of Lab	Completion of design	
<i>ECTS credits</i>	4		1	1	
<i>Total Student's Workload</i>	120		30	30	

- Level of the course (basic/advanced): **basic**
- Prerequisites: **Grounded knowledge on electricity and passed grade of: Electrical measurement, Electrical machines, Electrical devices, Electrical power systems**
- Name, first name and degree of the lecturer/supervisor: **Prof. Bogdan Miedziński Ph.D., D.Sc.**
- Names, first names and degrees of the team's members:
Mieczysław Zielichowski, Ph.D., D.Sc.
Henryk Belka, Ph.D.
Witold Dzierżanowski, Ph.D.
Wilhelm Rojewski, Ph.D.
Grzegorz Wiśniewski, Ph.D.
- Year:.....**III / I stage**..... Semester:.....**6**.....
- Type of the course (obligatory/optional): **obligatory**
- Aims of the course (effects of the course): **recognition of main measuring and realization principles of power system protections.**
- Form of the teaching (traditional/e-learning): **traditional**
- Course description: **Objects and tasks of. power system protection. Main requirements related to power system relaying. Converters of measurement quantities for protection needs. Measuring relays with single and multi input energizing quantities. Relaying principles of main power system elements, it is: generators, transformers, high voltage motors, distribution and transmission lines. Power system protection of preventive and restoration mode (reclosing, supplying restoration, load shedding) – object and general application principles.**
- Lecture:

<i>Particular lectures contents</i>	<i>Number of hours</i>
1. The tasks of power system protection, ground definition and requirements	2
2. Relays and relay systems, relays generation, development tendency	2
3. Converters of measuring quantities, instrument transformers,	

symmetrical components filters	2
4. Single input relays with undependent and time-dependent characteristic, thermal relays	2
5. Multi input relays – directional, differential, distance relays	3
6. Synchronous generators protection, of: stator, rotor and excitation circuits	3
7. Transformer protection	3
8. High-voltage motors – synchronous and non synchronous – protection	3
9. Disturbances in distribution and transmission power systems	1
10. Distribution power system protections	3
11. Transmission power system protections	3
12. Object and principles of application related to protection of preventive and restoration mode (automatic reclosing, automatic restoration and load shedding)	3

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
 1. Introduction, information about pass of grade form
 2. Testing of measuring quantities converters
 3. Testing of single input relays
 4. Testing of directional relays
 5. Testing of differential relays
 6. Testing of distance relay
- Project – the contents:

The project covers:

 1. Calculations of values of characteristic fault signals,
 2. Specification of the range of equipping the device with protection systems,
 3. Selection of protective equipment,
 4. Selection of setting of protections,
 5. Checking of sensitivity of protections,
 6. Working out the protection schemes indicated by the supervisor
- Basic literature:
 1. Synal B., Elektroenergetyczna automatyka zabezpieczeniowa – podstawy, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000.
 2. Synal B., Rojewski W., Dzierżanowski W., j. w. – wydanie II poprawione i uzupełnione, Wrocław 2003.
 3. Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa, 1999, oraz wydanie II 2004.
 4. Praca zbiorowa pod red. B. Synala, Automatyka elektroenergetyczna, ćwiczenia laboratoryjne, część I: Przetworniki sygnałów pomiarowych i przekaźniki automatyki zabezpieczeniowej, część II: Układy automatyki zabezpieczeniowej i regulacyjnej skrypt Politechniki Wrocławskiej, Wrocław 1991.
- Additional literature:
 1. Wiszniewski A., Algorytmy pomiarów cyfrowych w automatyce elektroenergetycznej, WNT, W-wa, 1990.
 2. Horowitz S. H., Phadke A.G., Power system relaying, RSP England 1992.

3. Wróblewski J., Zespoły elektroenergetycznej automatyki zabezpieczeniowej, WNT, W-wa, 1993.
4. Ungrad H., Winkler W., Wiszniewski A., Protection techniques in electrical energy systems, Marcel Dekker Inc., New York 1995.

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Conditions of the course
acceptance/creditation: **Exam,**
Completion of Lab and Project

* - depending on a system of studies