DESCRIPTION OF THE COURSES

- Course code: ARR2109
- Course title: DIGITAL TECHNIQUES IN POWER SYSTEM CONTROL AND PROTECTION
- Language of the lecturer: Polish

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*1*			*2*	
*Number of hours/semester**	*15*			*30*	
Form of the course completion	*pass*			*pass*	
ECTS credits	*1*			*2*	
Total Student's Workload	*30*			*60*	

- Level of the course (basic/advanced):): basic
- Prerequisites:
  Completed course: Fundamentals of digital control and protection.
- Name, first name and degree of the lecturer/supervisor:
  Jan Iżykowski, Ph.D., D.Sc.
- Names, first names and degrees of the team's members:

- Year: 4 Semester: 8
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):
  Familiarization with selected modern digital techniques in power system control and protection. Gain of basic knowledge with respect to distributed measurements in power system control and protection, performed with use of satellite system GPS.
- Form of the teaching (traditional/e-learning): traditional
- Course description:
  The course consists of the lecture and the project. The lecture delivers the selected topics of modern digital control and protection systems and deals with the following issues. Voltage and current instrument transformers for protective relaying. Dynamic compensation of voltage and current transformers. Digital algorithms designated to fault detection, fault classification and discriminating the direction of faults on power lines. Modern communication means for power system control and protection. Synchronized measurements – Global Positioning System (GPS). Synchrophasors – application examples (power system protection, fault location). Analytical synchronisation of distributed measurements in case of unavailability of GPS. The project requires modelling (program ATPDraw) and investigating the selected algorithms of digital control and protection systems (program MATLAB).
- Lecture:

Particular lectures contents	*Number of hours*
1. Introduction into the course topics.	*1*

2. *Voltage and current instrument transformers –issue of application the transformers to supplying digital protective devices.*	*1*
3. *Digital compensation of transformation errors of capacitor voltage transformers.*	*2*
4. *Digital algorithms for detecting saturation of current transformers and for compensation of their transformation errors.*	*2*
5. *Digital algorithms for fault detection, fault classification and direction discrimination of faults on power lines.*	*2*
6. *Modern communication means for power system control and protection. Synchronized measurements - Global Positioning System (GPS).*	*2*
7. *Synchrophasors – application examples (power system protection, fault location).*	*2*
8. *Analytical synchronisation of distributed measurements in case of unavailability of GPS.*	*2*
9. *Pass test.*	*1*

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:
- Project – the contents:
  Individual projects requiring modelling (program ATPDraw) of the given power network, as well as and investigating the selected algorithms of digital control and protection systems (program MATLAB), with use of the signals obtained from the simulation.
- Basic literature:

[1] Iżykowski J., *Impedancyjne algorytmy lokalizacji zwarć w liniach przesyłowych*, Prace Naukowe Instytutu Energoelektryki Politechniki Wrocławskiej Nr 92, Seria: Monografie – nr 28, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2001.

[2] Rosołowski E., Cyfrowe przetwarzanie sygnałów w automatyce elektroenergetycznej. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2002.

[3] Szafran J., Wiszniewski A., Algorytmy pomiarowe i decyzyjne cyfrowej automatyki elektroenergetycznej, WNT, Warszawa, 2001.

- Additional literature:

[1] SACHDEV M.S. (co-ordinator), *Advancements in microprocessor based protection and communication*, IEEE Tutorial, IEEE Publication No. 97TP120–0, 1997.

[2] IEEE Std. C37.118: "IEEE Standard for Synchrophasors for Power Systems", *IEEE Power Engineering Society Publ.*, pp. 1-65, 22 March 2006.

[3] Selected papers from journals and conference proceedings.

- Conditions of the course acceptance/credition:

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