

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Automatyka zabezpieczeniowa**
 Name in English: **Power System Protection**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Electrical Power Engineering**
 Level and form of studies: **2nd level, part-time**
 Kind of subject: **obligatory**
 Subject code: **ELR052272**
 Group of courses: **NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|--|----------------------|---------|----------------------|---------|---------|
| Number of hours of organized classes in University (ZZU): | 11 | | 22 | | |
| Number of hours of total student workload (CNPS): | 30 | | 90 | | |
| Form of crediting: | crediting with grade | | crediting with grade | | |
| For group of courses mark (X) final course: | | | | | |
| Number of ECTS points: | 1 | | 3 | | |
| including number of ECTS points for practical (P) classes : | | | 3 | | |
| including number of ECTS points for direct teacher-student contact (BK) classes: | 0.70 | | 2.10 | | |

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has properly founded and structured knowledge needed to understand the purposes and targets of modern power system protection.
2. Has basic knowledge about operation criteria and application techniques of protection of main power system elements
3. Is able to correctly conduct testing of digital as well as analog relay protection units.

SUBJECT OBJECTIVES

- C1. Acquaintance with modern solutions for power system protection
 C2. To gain practical knowledge and skills for selection of proper relaying criteria for machinery and electrical networks
 C3. To gain practical skills to apply modern methods, techniques and measuring tools for individual relays and sets of protection testing
 C4. To gain practical skills needed for connecting secondary circuits of relay protection, conducting testing and preparing reports

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Has consolidated and well founded theoretical knowledge necessary to understand functions and operation principles of modern control automatic and protection (eliminative, regenerative and preventive) of power system
 PEU_W02 Understands methodology of calculation of criteria quantities and set up values of power system protections reacting on phase-to-phase faults.

relating to skills:

- PEU_U01 Is able to connect secondary current and voltage circuits of relay protections.
 PEU_U02 Is able to select proper sets of relays and to measure characteristics of protection.

relating to social competences:

- PEU_K01 Is conscious about responsibility for his own work and is willing to acknowledge teamwork rules.

PROGRAMME CONTENT

| Form of classes - lecture | | Number of hours: |
|---------------------------|--|------------------|
| Lec 1 | Overview of lecture, requirements, literature and assessment methods. Basic characteristics, classification and role of power system eliminative, preventive and regenerative protection | 2 |
| Lec 2 | Principles of operation and setting up of automatic switching of feeding system. Problems with switching of feeding of asynchronous motors. Characterization of transient faults. Overview on requirements for auto reclosing automatics. Operation criteria and principles of setting of auto reclosing equipment in transmission and distribution lines. | 2 |
| Lec 3 | Criterion for solution, setting and operation of Under Frequency Load Shedding equipment (UFLS). Principles and criterion of operation and setting of Under Voltage Load Shedding equipment (UVLS). | 2 |
| Lec 4 | The functions of special protection in electric power system. Examples of practical solutions. Application of synchrophazors in power system protection. | 2 |
| Lec 5 | Methods and equipment for automatic fault localization and switching in distribution network. Self healing networks. Communication protocols used in relays. | 2 |
| Lec 6 | Evaluation test | 1 |
| Total hours: | | 11 |

| Form of classes - laboratory | | Number of hours: |
|------------------------------|--|------------------|
| Lab 1 | Presentation of safety regulations and regulations of laboratory. Assessment rules. Overview of laboratory stations. | 2 |
| Lab 2 | Test of zero sequence current filters | 2 |
| Lab 3 | Test of inverse time-delay relays | 2 |
| Lab 4 | Test of HV motors protection | 2 |
| Lab 5 | Test of distance relays | 2 |
| Lab 6 | Test of automatic switching of feeding system | 2 |
| Lab 7 | Test of auto-reclosing units | 2 |
| Lab 8 | Test of power lines differential protection | 2 |
| Lab 9 | Test of synchronous generators protections | 2 |
| Lab 10 | Testing of relays with specialized tester | 2 |
| Lab 11 | Assessment and completion of test reports | 2 |
| Total hours: | | 22 |

TEACHING TOOLS USED

- N1. Problem lecture
- N2. Lecture with use of multimedia techniques.
- N3. Laboratory with measurements traditionally arranged
- N4. Assessment in form of oral or writing test
- N5. Preparation of tests and measurements report

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i> | Educational effect number | Way of evaluating educational effect achievement |
|---|-------------------------------|--|
| F1(W) | PEU_W01 PEU_W02 | Evaluation test |
| P(W) | P=F1 | |
| F1(L) | PEU_U01 PEU_U02 PEU_K01 | Preparation for laboratory assessment and activity during laboratory |
| F2(L) | PEU_U01 PEU_U02 PEU_K01 | Assessment of laboratory reports |
| P(L) | P=0,5F1+0,5F2 | |

| |
|---|
| PRIMARY AND SECONDARY LITERATURE |
|---|

| |
|----------------------------|
| PRIMARY LITERATURE: |
|----------------------------|

- | |
|---|
| <p>[1] Synal B. i inni, Elektroenergetyczna automatyka zabezpieczeniowa – podstawy, Wyd. II, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003.</p> <p>[2] Winkler W., Wiszniewski A., Automatyka zabezpieczeniowa w systemach elektroenergetycznych, WNT, Warszawa, 2004</p> <p>[3] Żydanowicz J., Elektroenergetyczna automatyka zabezpieczeniowa: 1. Podstawy zabezpieczeń elektroenergetycznych, Warszawa, WNT, 1979; 2. Automatyka eliminacyjna, Warszawa, WNT, 1985; 3. Automatyka przewencyjna i restytucyjna, Warszawa, WNT, 1987.</p> <p>[4] Machowski J.: Regulacja i stabilność systemu elektroenergetycznego</p> <p>[5] Praca zbiorowa pod red. B. Synala, Automatyka Elektroenergetyczna, ćwiczenia laboratoryjne cz.I : Przetworniki sygnałów pomiarowych i przekaźniki automatyki zabezpieczeniowej, cz.II : Układy automatyki zabezpieczeniowej i regulacyjnej, Skrypt Politechniki Wrocławskiej, Wrocław 1991</p> <p>[6] Kacejko P., Machowski J.: Zwarcia w systemach elektroenergetycznych, WNT, Warszawa, 2002.</p> <p>[7] PN-EN 60909-0 Prądy zwarciorowe w sieciach trójfazowych prądu przemiennego- Część 0: Obliczanie prądów.</p> |
|---|

| |
|------------------------------|
| SECONDARY LITERATURE: |
|------------------------------|

- | |
|--|
| <p>[1] Konspekty prowadzącego</p> <p>[2] Wiszniewski A., Algorytmy pomiarów cyfrowych w automatyce elektroenergetycznej, WNT, Warszawa, 1990</p> <p>[3] Instrukcje laboratoryjne</p> |
|--|

| |
|---------------------------|
| SUBJECT SUPERVISOR |
|---------------------------|

| |
|---|
| Marcin Habrych, marcin.habrych@pwr.edu.pl |
|---|