Warsaw University of Technology

# COURSE OFFERED IN THE DOCTORAL SCHOOL

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|---|---|---|---|---|---|
| Code of the course | 4606-ES-00000BI-0090 | Name of the course | Polish | **Inteligente sieci elektroenergetyczne** | |
| | | | English | **Smart Power Grids** | |
| Type of the course | SEED Visiting Professors (ViP – Task 4) | | | | |
| Course coordinator | Marek Jasinski WUT (Sertac Bayhan Hamad Bin Khalifa University) | | | | |
| Implementing unit | DOD+WE | Scientific discipline / disciplines* | Automation, electronics, and electrical engineering | | |
| Level of education | PhD Students | Semester | Winter | | |
| Language of the course | English | | | | |
| Type of assessment: | Test/project | Number of hours in a semester | 30 | ECTS credits | 2 |
| Minimum number of participants | 5 | Maximum number of participants | 25 | Available for students (BSc, MSc) | Yes/~~No~~ |

| Type of classes | | Lecture | Auditory classes | Project classes | Laboratory | Seminar |
|---|---|---|---|---|---|---|
| Number of hours | in a week | | | | | |
| | in a semester | | | | | 20 |

* does not apply to the Researcher's Workshop

## 1. Prerequisites

The seminar is for all kinds of Doctoral Studies, Doctoral Schools, and MSc students

## 2. Course objectives

1. The participant after the course is expected to:
2. – know how to recognize a smart power grid based on power electronics,
3. – know how to recognize power electronics converters,
4. – know how to smart power grids operate in modern power systems,
5. – understand energy efficiency, reliability, and environmental aspect of smart grids.

## 3. Course content (separate for each type of classes)

### Lecture / Seminar

Smart Power Grids course will provide fundamental insights into century-long energy studies that aim to match the demand with the supply, as well as a decade-long research and development efforts in Smart Grids to improve the energy efficiency, reliability, and environmental aspects of the power grids. More specifically, the course will provide a rich introduction to the new multidisciplinary field of smart grids, and it will cover a variety of special topics, including demand response, advanced metering networks, communication and sensing technologies, distributed energy generation and storage, electric vehicles, wide-area power system monitoring, energy markets, and cyber-security.

### Laboratory / Workshop

## 4. Learning outcomes

| | Learning outcomes description | Reference to the learning outcomes of the WUT DS | Learning outcomes verification methods* |
|---|---|---|---|
| Knowledge | | | |
| K01 | The world's achievements in science and the arts and the resulting implications of this for practice | SD_W2 | Active participation |
| K02 | | | |

| | | | |
|---|---|---|---|
| K03 | | | |
| Skills | | | |
| S01 | analyse and creatively synthesise scientifically and creative achievements to identify and solve research problems as well as those related to innovative and creative activities; contribute new elements to these achievements | SD_U1 | presentation evaluation |
| S02 | | | |
| S03 | | | |
| Social competences | | | |
| SC01 | conduct independent research which contributes to existing scientific and creative achievements; assume professional and public challenges taking into consideration:<br>• their ethical dimension<br>• responsibility for their results and develop models of good practice in such situations | SD_K5 | presentation evaluation |

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

## 5. Assessment criteria

The participants will be evaluated based on the following factors:
– 100% attendance
– project, test or tests.

## 6. Literature

[1] R. Javanovic, S. Bayhan, I. S. Bayram, “A multiobjective analysis of the potential of scheduling electrical vehicle charging for flattening the duck curve,” Journal of Computational Science, 2020, 101262, ISSN 1877-7503, https://doi.org/10.1016/j.jocs.2020.101262
[2] A. Khan, M. B. Shadmand, S. Bayhan and H. Abu-Rub, "A Power Ripple Compensator for DC Nanogrids via a Solid-State Converter," in IEEE Open Journal of the Industrial Electronics Society, doi: 10.1109/OJIES.2020.3035073.
[3] N.Guler, H.Komurcugil, S. Biricik, S. Bayhan, “Model Predictive Control of DC-DC SEPIC Converters with Auto-tuning Weighting Factor”, IEEE Transactions on Industrial Electronics, Accepted: 15/09/2020.
[4] D. Vinnikov, A. Chub, D. Zinchenko, V. Sidorov, M. Malinowski, S. Bayhan, “Topology-Morphing Photovoltaic Microconverter with Wide MPPT Voltage Window and Post-Fault Operation Capability”, IEEE Access, Vol. 8, pp. 153941-153955, 2020.

| 7. PhD student's workload necessary to achieve the learning outcomes** | | |
|---|---|---|
| No. | Description | Number of hours |
| 1 | Hours of scheduled instruction given by the academic teacher in the classroom | 20 |
| 2 | Hours of consultations with the academic teacher, exams, tests, etc. | 10 |
| 3 | Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework | 15 |
| 4 | Amount of time devoted to the preparation for exams, tests, assessments | 15 |
| | **Total number of hours** | **60** |
| | **ECTS credits** | **2** |

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)