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| **Course title:** | Advanced digital signal processing: statistical and adaptive approaches |
| **Course title in Polish:** | Zaawansowane cyfrowe przetwarzanie sygnałów: metody statystyczne i adaptacyjne |
| **Course for discipline:** | Information and communication technology |

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| **Semester:** | 3 | **Status of course:** | faculty | **Language:** | english |
| **Academic year:** | | **Catalog number:** | | | |

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| **Coordinator of course:** | prof. dr hab. inż. Andrzej Śluzek |
| **Lecturer od course:** | prof. dr hab. inż. Andrzej Śluzek |
| **Executing unit:** | Institute of Information Technology |
| **Ordering unit:** | Doctoral School SGGW |
| **Assumptions, goals and description of the course:** | This course is an advanced continuation of digital signal processing area, focusing on the processing of random and noisy signals (especially in the context of their spectral characteristics).<br>Upon completion of the course, students will possess the skills to analyze and model discrete random signals, analyze their spectral characteristics, and design optimal filters for selected problems in which such signals occur.<br>Main topics covered in the course:<br>• Summary of basic digital signal processing techniques.<br>• Models and characteristics of random signals.<br>• Linear models of random signal processing (MA, AR, and ARMA).<br>• Non-parametric spectral estimation methods (Barlett, Welch, Blackman-Tukey).<br>• Parametric spectral estimation methods (verification methods, spectrum whitening and coloring).<br>• Frequency estimation (Pisarenko and MUSIC methods).<br>• Wiener optimal filters (FIR and IIR).<br>• Matched and eigenfilters.<br>• Digital Kalman filters. |
| **Didactic form, number of hours:** | Tutorials, 10 hours |
| **Teaching methods:** | Tutorials with example problem solutions (using Matlab). |
| **Limit of people in the group:** | 10 |

**Learning outcomes**

| **KNOWLEDGE - the graduate knows and understands:** | **SKILLS - the graduate is able to:** | **COMPETENCES - the graduate is ready to:** |
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| To the extent enabling to revise the existing pradigms in the field/discipline - the world achievments, gathering theoretical background as well as general and selected detailed issues | Carry out critical assessment of the scientific research findings and expert activities and their contribution to the knowledge development in the field/discipline | Critically evaluate the achievments in the field/discipline represented |
| Major general development trends in the field/discipline | | Recognise knowledge in solving cognitive and practical problems characteristic for the area of research (field/discipline) and in an interdisciplinary aspect |
| | | Support the ethos of scientific circles and conduct independent research |

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| **The method of verification of learning outcomes:** | Completion of 5 problem-solving tasks covering the core topics of the course. |
| **Form of documentation of achieved learning outcomes:** | Description, code and outcomes of the solutions. |
| **Elements and weights of the final grade:** | Final assessment: 90% problem solutions (5x18%), 10% class activity. |
| **Place of the course:** | classroom |

**Basic and supplementary literature**

Basic literature:
D.G. Manolakis, V.K. Ingle, S.M. Kogon, Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing, Artech House, 2005.
Supplementary literature:
M. Hayes, Statistical Digital Signal Processing and Modeling, Wiley, 2008
The Digital Signal Processing Handbook, Vijay Madisetti (editor), CRC Press, 2009.

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| **Comments:** | n.a. |

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| **Estimated number of hours of work of the doctoral student necessary to achieve the assumed learning outcomes:** | |

**Leraning outcomes reference to the second degree characteristics of the National Qualification Framework (level 8) covering doctoral competences:**

| **Symbol:** | **Learning outcomes:** | **8 level NQF** |
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| SD1_KW01 | To the extent enabling to revise the existing pradigms in the field/discipline - the world achievments, gathering theoretical background as well as general and selected detailed issues | P8S_WG |
| SD1_KW02 | Major general development trends in the field/discipline | P8S_WG |
| SD1_KU05 | Carry out critical assessment of the scientific research findings and expert activities and their contribution to the knowledge development in the field/discipline | P8S_UW |
| SD1_KK01 | Critically evaluate the achievments in the field/discipline represented | P8S_KK |

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| SD1_KK03 | Recognise knowledge in solving cognitive and practical problems characteristic for the area of research (field/discipline) and in an interdisciplinary aspect | P8S_KK |
| SD1_KK08 | Support the ethos of scientific circles and conduct independent research | P8S_KR |