COURSE GUIDE

Subject name	**Smart Metering**
Course of study	**Management**
The form of study	**Full-time**
Level of qualification	**II level**
Year	**II**
Semester	**III**
The implementing entity	**Institute of Information Management Systems**
The person responsible for preparing	**Dr hab. Robert Kucęba Prof. P.Cz.**
Profile	**General academic**
Course type	**other**
ECTS points	**5**

TEACHNING METHODS – NUMBER OF HOURS PER SEMESTER

LACTURE	CLASS	LABORATORY	PROJECT	SEMINAR
15	**30**			

COURSE AIMS

C1. Understanding of modern measuring technology supply and demand of poli-generation energy with using innovative telecommunications systems and telemetry
C2. Understanding Advanced Technology Measuring AMI - management of distributed energy network elements from different production sources of energy, including renewable energy through its distribution systems to various consumers (including prosumers).
C3. Learn the principles of intelligent networks in the energy sector (SmartGrid).

ENTRY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of metrology.
2. Basics of computer networks.
3. Basic issues in the energy industry, including centralized and decentralized energy markets.

LEARNING OUTCOMES

EK 1 - The student is able to design simple structures including the intelligent network layers of the: consumer, operational, IT and smart metering.

EK 2 - Student is able to develop assumptions and design of distributed management system energy demand and supply in a decentralized environment.
EK 3 - The student knows and is able to use the Advanced Measurement Infrastructure AMI in the process of scheduling the demand and supply of energy in a decentralized system (including prosumers).
EK 4 - Student is able to generate Calendar Characteristics of Demand and Supply in a distributed environment, and define indicators of sustainable development in the decentralized systems.

COURSE CONTENT

Type of teaching – LECTURE	**Number of hours**
W1. The concept of smart grid systems and metering systems such as smart metering.	1
W2. Future electric power grid (smart, efficient, flexible, motivating, plug and play, high quality, resistant, ecology).	1
W3, W4. Discussion of the layers of the distributed measurement system: Layer 1 - measurement and data acquisition, Layer 2 - data transmission measurement, Layer 3 - center for the collection of measurement data, Layer 4 - central processing environment and data visualization.	2
W5, W6. W7, W8. The measuring instruments used in smart metering: two-way meters, analyzers, registers, universal measuring instruments (such as electricity, gas, water, heat), remote change of tariffs, automatic reading of media consumption and the drawing up of accounts and analyzes such as the nature of the fuel, providing current data on current water consumption for entities such as distributor, vendor, end user (including prosumer).	4
W9, W10. Smart metering in the energy management of distributed systems. Basic components: processors, protocols and media data, design tools, tools for integration and commissioning.	2
W11, W12. Advanced Measuring Infrastructure (AMI)	2
W13, W14. Scheduling principles of supply and demand of energy in decentralized systems (including prosumers).	2
W15. Use Smart Metering measurement of sustainable development of the regions.	1
Type of teaching – CLASSES	**Number of hours**
C1, C2 Introduction to the course. Discussion of rules complete the course. Discussion of the range of material carried on exercises.	2
C3, C4 Introduction to smart metering in smart grid networks on the example of ION Enterprise.	2
C75, C6, C7 Generating a graphic calendar of supply and demand in decentralized energy sources.	3
C8, C9, C10 Calendar characteristics: peak loads, medium and in the valleys under the electric power.	3
C11, C12, C13 Analysis of balancing the demand of energy supply.	3
C14, C15, C16 Generating sustainable development indicators in the field of climate and energy - reduction of fossil fuel.	3
C17, C18, C19 Generating sustainable development indicators in the field of climate and energy - reduction of greenhouse gas emissions.	3
C20, C21, C22 Generating sustainable development indicators in the field of climate and energy - renewable energy growth in the decentralized system.	3
C23, C24 Project of intelligent measuring structure Smart Metering.	2
C25, C26, C27 Advanced Measurement Infrastructure Project (AMI).	3
C28, C29 Simulation virtual space Advanced Measurement Infrastructure (AMI).	2
C30 Check reports and projects.	1

TEACHNING TOOLS

1. Textbooks and scripts
2. Visual Equipment
3. Use cases diagrams
4. Graphics workloads and availability

WAYS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

F1. Reports
P1. Project

STUDENT WORKLOAD

Form of activity		Average number of hours for realization of the activity		
		[h]	ECTS	ECTS
Contact hours with the teacher	LECTURE	**15**	**1**	**1**
Contact hours with the teacher	CLASSES	**30**	**2**	**3,5**
Preparation for classes		**60**	**1,5**	
Getting Acquainted with the indicated literature		**10**	**0,25**	**0,25**
Consultation		**10**	**0,25**	**0,25**
TOTAL NUMBER OF HOURS / ECTS CREDITS FOR THE COURSE		**∑ 125 h**	**5**	

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

Basic resources:

1. **Kucęba R.:** Virtual power plant. Selected aspects of the organization and management of entities distributed generation, Publisher: Scientific Society for Organization and Management "Home Organizer", Torun 2011
2. http://ise.ews21.pl/ - portal dedicated to smart energy networks
3. http://www.smartgridspolska.pl/ - publishing portal for intelligent networks

Supplementary resources:

1. **Niedziółka D.:** Green Energy in Poland, CeDeWu.pl, Warsaw 2012
2. **Popczyk J.:** Power dissipated PKEOM, Warsaw 2011
3. The Energy Regulatory Office: Polish energy policy - yesterday, today, tomorrow, the Regulator Library, Warsaw 2010.

TEACHERS (NAME, SURNAME, ADRES E-MAIL)

1. dr hab. Robert Kucęba Prof. PCz. (robertk@zim.pcz.pl)

MATRIX OF LEARNING OUTCOMES REALISATION

Learning outcome	Reference of given outcome to outcomes defined for whole program	Course aims	Course content	Teaching tools	Ways of assessment
EK1	K_W01, K_W04, K_U10, K_U11, K_U12, K_K01	C1, C2	W1-W4, C3 - C4 C25 – C29	1,2	F1,
EK2	K_W01, K_W04, K_U10, K_U11, K_U12, K_K01	C2, C3	W5 – W10, C17 – C24	1,2,3,4	F1, P1

EK3	K_W01, K_W04, K_U10, K_U11, K_U12, K_K01	C2, C3	W11 –W12, C2 – C13, C17 – C24	1,2,3,4	F1
EK4	K_W01, K_W04, K_U10, K_U11, K_U12, K_K01	C2, C3	W13 – W15, C2 – C12, C17 – C29	1,2,3,4	F1, P1

FORM OF ASSESSMENT - DETAILS

	grade 2	grade 3	grade 4	grade 5
EK1	The student is not able to design simple structures including the intelligent network layers consumer, operational, IT and smart metering.	The student is not able to design simple structures but knows intelligent network layer knows the consumer, operational, IT and smart metering.	The student is able to design simple structures but knows intelligent network layer knows the consumer, operational, IT and smart metering.	The student is able to design simple structures but knows intelligent network layer knows the consumer, operational, IT and smart metering. He knows their mapping practical.
EK2	The student is not able to develop a distributed system management assumptions energy demand and supply in a decentralized environment. He can't design this environment.	Student is able to develop a foundation of distributed management system energy demand and supply in a decentralized environment. He can't design this environment.	Student is able to develop a foundation of distributed management system energy demand and supply in a decentralized environment. He can design - the environment.	Student is able to develop a foundation of distributed management system energy demand and supply in a decentralized environment. He can design this environment. He knows their mapping practical.
EK3	The student doesn't know and can't use the Advanced Measurement Infrastructure AMI in the process of scheduling the demand and supply of energy in a decentralized system (including prosumers).	The student doesn't know but he can use the Advanced Measurement Infrastructure AMI in the process of scheduling the demand and supply of energy in a decentralized system (including prosumers).	The student knows and is able to use the Advanced Measurement Infrastructure AMI in the process of scheduling the demand and supply of energy in a decentralized system (including prosumers).	The student knows and is able to use the Advanced Measurement Infrastructure AMI in the process of scheduling the demand and supply of energy in a decentralized system (including prosumers). He knows their mapping practical.
EK4	A student can't generate Calendar Characteristics of Demand and Supply in a distributed environment and can't define indicators of sustainable development.	A student can't generate Calendar Characteristics of Demand and Supply in a distributed environment but he can define indicators of sustainable development.	A student can generate Calendar characteristics of Demand and Supply in a distributed environment and he can define indicators of sustainable development.	A student can generate Calendar characteristics of Demand and Supply in a distributed environment and he can define indicators of sustainable development. He knows their mapping practical.

ADDITIONAL USEFUL INFORMATION ABOUT THE COURSE

1. Information where presentation of classes, instruction, subjects of seminars can be found, etc. - information presented to students in the classroom, if required by the formula classes are sent electronically to the e-mail

addresses of individual groups of students.

2. Information about the place of classes - information can be found on the website of the Faculty of Management
3. Information about the timing of classes (day of the week / time) - information can be found on the website of the Faculty of Management
4. Information about the consultation (time + place) -information is provided to students during the first class, information can be found on the website of the Faculty of Management and on the information board of the Institute of Information Management Systems (fourth floor).

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Coordinator