COURSE GUIDE

Course title	**Smart Metering**
Specialization	**Management**
Form of study	**Full-time studies**
Qualification level	**Second-degree studies**
Year	**2**
Semester	**III**
Unit running the program	**Department of Information Management Systems**
Author	**Dr hab. Robert Kucęba, Prof. PCz**
Profile	**General academic**
Number of ECTS credits	**5**

COURSE TYPE – NUMBER OF SEMESTER HOURS

LECTURE	CLASSES	LABORATORY	PROJECT	SEMINAR
15	**30**	**-**	**-**	**-**

COURSE DESCRIPTION

COURSE OBJECTIVE

O1. Understanding of modern measuring technology supply and demand of poli–generation energy with using innovative telecommunications systems and telemetry
O2. 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).
O3. Learn the principles of intelligent networks in the energy sector (SmartGrid).

INITIAL REQUIREMENT FOR THE KNOWLEDGE, ABILITIES AND OTHER COMPETENCES

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

THE EFFECTS OF EDUCATION

EU 1 – The student is able to design simple structures including the intelligent network layers of the: consumer, operational, IT and smart metering.
EU 2 – Student is able to develop assumptions and design of distributed management system energy demand and supply in a decentralized environment.
EU 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).
EU 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

Form of teaching – LECTURE 15 hours	Number of hours
L1 The concept of smart grid systems and metering systems such as smart metering.	**1**
L2 Future electric power grid (smart, efficient, flexible, motivating, plug and play, high quality, resistant, ecology).	**1**
L3, 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**

L5, L6, L7, L8 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**
L9, L10 Smart metering in the energy management of distributed systems. Basic components: processors, protocols and media data, design tools, tools for integration and commissioning.	**2**
L11, L12 Advanced Measuring Infrastructure (AMI)	**2**
L13, L14 Scheduling principles of supply and demand of energy in decentralized systems (including prosumers).	**2**
L15 Use Smart Metering measurement of sustainable development of the regions.	**1**
Form of teaching – CLASSES 30 hours	**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**
C1, C2 Introduction to the course. Discussion of rules complete the course. Discussion of the range of material carried on exercises.	**2**

TEACHNING TOOLS
Textbooks and scripts
Visual Equipment
Use cases diagrams
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		**55**	**1,5**	
Getting Acquainted with the indicated literature		**10**	**0,25**	**0,25**

Consultation	**15**	**0,25**	**0,25**
TOTAL NUMBER OF HOURS / ECTS CREDITS FOR THE COURSE	**∑ 125 h**	**5**	

BASIC AND SUPPLEMENTARY LITERATURE

Basic literature

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.
http://ise.ews21.pl/ – portal dedicated to smart energy networks.
http://www.smartgridspolska.pl/ – publishing portal for intelligent networks.

Supplementary literature

Frangopoulos CH. A. (ed.): Cogeneration, Institution of Engineering and Technology, 2017.
Moreno-Muoz A. (ed): Large Scale Grid Integration of Renewable Energy Sources, Institution of Engineering and Technology, 2017.
Niedziółka D.: Green Energy in Poland, CeDeWu.pl, Warsaw 2012.
Popczyk J.: Power dissipated PKEOM, Warsaw 2011.
Salman S. K.: Introduction to the Smart Grid, Institution of Engineering and Technology, 2017.
Solorio I., Jorgens H. (ed.): A Guide to EU Renewable Energy Policy, Elgar 2017.

TEACHERS (NAME, SURNAME, ADRES E–MAIL)

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MATRIX OF REALIZATION OF LEARNING EFFECTS

The learning effect	Reference to the effects of the defined effects for the entire program (PEK)	Course aims	Course content	Teaching tools	Evaluation method
EU 1	K_W01, K_W04, K_W12, K_U01, K_U02 K_U10, K_K01	C1,C2	L1 – L4 C3 – C4 C25 – C29	1,2	F1
EU 2	K_W01, K_W04, K_W12, K_U01, K_U02 K_U10, K_K01	C2,C3	L5 – L10 C17 – C24	1,2,3,4	F1,P1
EU 3	K_W01, K_W04, K_W12, K_U01, K_U02 K_U10, K_K01	C2,C3	L11 –L12 C2 – C13 C17 – C24	1,2,3,4	F1
EU 4	K_W01, K_W04, K_W12, K_U01, K_U02 K_U10, K_K01	C2,C3	L13 – L15 C2 – C12 C17 – C29	1,2,3,4	F1,P1

EVALUATION FORM – DETAILS

	For a grade of 2	For a grade of 3	For a grade of 4	For a grade of 5
Effect 1	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.

Effect 2	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.
Effect 3	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.
Effect 4	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.

OTHER USEFUL INFORMATION ABOUT THE SUBJECT

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.

Information about the place of classes – information can be found on the website of the Faculty of Management.

Information about the timing of classes (day of the week / time) – information can be found on the website of the Faculty of Management.

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).