Faculty of Electrical Engineering, Computer Science and Telecommunications

University of Zielona Góra

INFORMATION BOOKLET

Subject Area: **ELECTRICAL ENGINEERING**

Second-cycle Level Studies

(Full-time, Part-time)

Academic Year 2011/2012

European Credit Transfer System ECTS

Part II.B

ECTS COURSE CATALOGUE
ELECTRICAL ENGINEERING

SECOND-CYCLE LEVEL STUDY (M.Sc.Degree)

TABLE OF CONTENTS

SPECIALIST SUBJECTS

SELECTED ISSUES OF CIRCUIT THEORY I

Course code: 06.2-WE-E-WZT1-PK2_S2S

Type of course: Compulsory

Entry requirements: -

Language of instruction: Polish

Director of studies: dr inż. Radosław Kłosiński

Name of lecturer: dr inż. Radosław Kłosiński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	I	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Exam	
Laboratory	18	2		Grade	

COURSE CONTENTS:

Flow diagrams of circuits. Mason's signal flow diagrams. Flow diagram for electrical circuit construction. Flow diagram transformations. Mason's rules.

Continuous linear time-invariant systems. Circuit treated as an input output system. Differential equations of circuit. Transfer function, circuit operator. Linearity, causality, time-invariance. Impulse response. Convolution and rational functions. Stability. Feedback. Periodic excitation, circular convolution, circular impulse response. Circuit sensitivity.

Discrete time signals and systems. Sampling of continuous signals. Digital filters – Basic concepts. Discrete systems impulse response and linear convolution. Z transformation. Recursive and non-recursive filters (IIR and FIR filters). Digital filters stability. Transient state of digital filters. Periodic steady state of digital filters, circular convolution. Discrete simulation of continuous systems. Introductory discrete linear time-varying systems theory.

Spectral analysis. Continuous Fourier transformation. Time and frequency domain sampling. Other versions of Fourier transformation: Fourier series, discrete Fourier transformation. Frequency response of linear time-invariant continuous and digital filters.

LEARNING OUTCOMES:

Basic knowledge and understanding of circuit theory issues, i.e. linear circuits description methods (transfer function, impulse response, convolution); linear circuits sensitive analysis; description and analysis of discrete time (digital) systems, spectral analysis of continuous and discrete systems.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

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RECOMMENDED READING:

[1] Siwczyński M.: *Circuits and signals theory, part I Linear electric circuits*, RWNT, Zielona Góra 2002.

[2] Siwczyński M.: *Issues and problems of circuits and systems theory, functional approach. Vol.1. Linear lumped-parameter systems.* Printed series of course lectures of WSI in Zielona Góra, 1986

[3] Zieliński T.P.: „*From theory to digital signal processing*". Dep. EAIiE AGH, Kraków 2002. (in Polish)

[4] Oppenheim A.V., Willsky A.S., Nawab S.H.: „*Signal & Systems*". Prentice Hall 1997.

[5] Papoulis A.: *Circuits and Systems. A modern Approach*. Holt, Rinehart and Winston, Inc. 1980.

[6] Lyons R.G.: „*Understanding Digital Signal Processing*". Addison Wesley Longan, Inc. 2004.

[7] Dąbrowski A.: Signal processing by means of signal processors. WPP, Poznań, 2000

[8] Krakowski M.: Theoretical electrical engineering, Vol. I, Linear and non-linear circuits. PWN, Warszawa, 1983.

[9] Osiowski J., Szabatin J.: Circuit theory principles, WNT Warszawa 1998. (in Polish)

OPTIONAL READING:

[1] –

SELECTED ISSUES OF CIRCUIT THEORY II

Course code: 06.2-WE-E-WZT2-PK3_S2S

Type of course: Compulsory

Entry requirements: -

Language of instruction: Polish

Director of studies: Prof dr hab inż. Igor Korotyeyev

Name of lecturer: Prof dr hab inż. Igor Korotyeyev

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	II	Exam	
Part-time studies					
Lecture	18	1	II	Exam	

COURSE CONTENTS:

Description methods for 3-phase systems. State description problems of multiphase systems with non-sinus processes. Fortescue's conception. Modal analysis. Clarke-Parka's transform.

Linear system synthesis. Frequency characteristics and their approximation. Two-terminal and four-terminal networks. Analog Butterworth's and Czebyszew's filters. Examples of circuit realization of analog active filters. Numerical filter designing by analog prototype. SOI filter designing with linear phase. Sensitivity analysis.

Nonlinear circuit theory. Bases of description methods and nonlinear system analyses. Linearization method, Newton's method, homotopy method, stable point method. Consecutive and parallel ferroresonance, Introduction in numerical solution of nonlinear differential equations. Numerical simulation of time-dependent nonlinear systems by time series approximation. Stability of nonlinear systems.

LEARNING OUTCOMES:

Skills and competence: problem comprehension in electrical systems; circuit synthesis and its circuit realization; linear circuit analyses in the view of their sensitivity for parameters; problem comprehension of nonlinear circuits.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

RECOMMENDED READING:

[1] Zieliński T.P.: *From theory to numerical signal transformation*, EAIiE AGH department, Kraków, 2002. (in Polish)

[2] Oppenheim A.V., Schafer R.W.: *Numerical signal transformation*, WKŁ, Warszawa, 1979. (in Polish)

[3] Papoulis A.: *Circuits and systems*, WKŁ, Warszawa, 1988. (in Polish)

[4] Lyons R.G.: *Introduction to numerical signal transformation*, WKŁ, Warszawa, 1999. (in Polish)

[5] Dąbrowski A.: *Signal transformation by signal processors,* WPP, Poznań, 2000. (in polish)

[6] Osiowski J., Szabatin J.: *Circuit theory bases*, WNT, Warszawa, 1998. (in Polish)

OPTIONAL READING:

[1] –

ELECTROMECHANICAL DRIVE SYSTEMS

Course code: 06.2-WE-E-ESN-PK4_S2S

Type of course: Compulsory

Entry requirements: -

Language of instruction: Polish

Director of studies: Dr inż. Robert Smoleński

Name of lecturer: Dr inż. Robert Smoleński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	I	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Grade	
Laboratory	9	1		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Drive systems. Dynamics of electric drives. Equation describing dynamics of drives. Dynamics equation of electromechanical systems.

Modeling of steady and dynamic state of electric drive. General properties of nonlinear systems. Mathematical models of electric machines and drive systems. Identification of parameters of equivalent circuits of drive systems. Dynamic state in electric drives. Influence of drive dynamic state on power grid.

Power converter multi-drives. Selection of parameters of power converter drives in drive systems. Regenerative breaking in multi-drive systems.

Analysis of energetic and mechanical properties of power converter drives. Two- and four quadrant asynchronous drives. DC converter drives, permanent magnet and reluctance converter drives. Brushless DC motors.

LEARNING OUTCOMES:

Skills and competences in: formation of equations describing simple drive systems; identification of electromechanical drive system parameters, usage of numerical analysis methods; selection of parameters of power converter drives in drive systems.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Boldea I., Nasar S.A, *Electric Drives*, CRC Press, 1999.

[2] Sen P.C.: *Principles of Electrical Machines and Power Electronics*, John Willey and Sons, Inc., New York, USA. 1997.Kaźmierkowski M. P., Tunia H.: *Automatic Control of Converter-Fed Drives*, Warsaw - Amsterdam - New York - Tokyo: PWN-ELSEVIER SCIENCE PUBLISHERS, 1994.

[3] Kaźmierkowski M. P., Blaabjerg F., Krishnan R.: *Control in Power Electronics, Selected Problems*, Elsevier 2002.

[4] Kaźmierkowski M. P. and Orłowska-Kowalska T.: *Neural Network estimation and neuro-fuzzy control in converter-fed induction motor drives, Chapter in Soft Computing in Industrial Electronics*, Springer-Verlag, Heidelberg, 2002.

[5] Leonhard W.: *Control of Electrical Drives*, Springer, Berlin, New York, 2001.

[6] Miller T.J.E.: *Brushless Permanent-Magnet and Reluctance Motor Drives*, Oxford University Press, Oxford, England, 1989.

OPTIONAL READING:

[1] –

FAULTS IN POWER SYSTEMS

Course code: 06.2-WE-E-ZUE-PK6_S2S

Type of course: Compulsory

Entry requirements: -

Language of instruction: Polish

Director of studies: Dr hab. inż. Adam Kempski, prof. UZ

Name of lecturer: Dr hab. inż. Adam Kempski, prof. UZ, dr inż. Jacek Rusiński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	I	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Grade	
Laboratory	9	1		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Transients and electromagnetic distortions in electrical power engineering systems. Classification of distortions. Influences of transients on electrical power system and its elements behavior. Voltage dips and supply interruptions influence on behavior of electrical loads.

Overvoltages in electrical power system. Reasons, effects and overvoltages classification. External and internal overvoltages in high voltage electric al Power system. Lightning overvoltages. Wave phenomena in electrical power transmission power lines. Lightning protection and transit overvoltage protection. Coordination of overvoltage protection.

Short-circuits in electrical power system. Reasons, effects and short-circuits classification. Transients caused by short-circuits and switchings in high voltage level arrangements. Influences of the short-circuit currents. Short-circuit calculations. Electro-mechanical transients and power system stability.

Power system protection . Methods of fault detection in power system. Relay protection system in electrical power system. Power system co-ordination in fault conditions.

LEARNING OUTCOMES:

Skills and competences in: understanding problems related to reasons and effects of transients states in the electrical power systems.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Machowski J., et all: *Power system dynamics and stability*, John Wiley & Sons, 1997.

[2] Song Y., Johns A.: *Flexible AC transmission systems (FACTS)*, IEE Power and Energy Series 30, TJ International Ltd, Padstow, Cornwall, 1999.

[3] Flisowski Z.: High voltage technique, WNT W-wa, 2005 (in Polish).

[4] Kufel J., Kufel E., Zaengl W.S.: High voltage engineering Fundamentals, Elsevier 2000.

[5] Ungrad H., Winkler W. Wiszniewski: *Protection Techniques in Electrical energy systems*. Marcel Dekker Inc. 1995.

OPTIONAL READING:

[1] –

ADVANCED CONTROL SYSTEMS AND COMPUTER NETWORKS

Course code: 06.0-WE-E-ZSSS-PSW_A7_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: Prof. dr hab. inż. Igor Korotyeyev, dr inż. Grzegorz Kobyłecki

Name of lecturer: Prof. dr hab. inż. Igor Korotyeyev

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Project	30	1		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Voltage control techniques. The method of the fundamental harmonic identification. Integral methods. Basis of the transient power theory. Theory of the transient power in orthogonal coordinates. Control techniques of power transmission.

Variable structure control. Phase plane method. Development methods of variable structure systems. Idea of making of induced movement. Sliding mode existence condition.

Neural networks. Unilateral networks. Recursive networks. Teaching methods for neural networks. Method of reverse propagation. Neural network in adaptation system. Neural control systems.

Fuzzy logic control. Models of fuzzy logic system. Fuzzy logic control in industry. Control systems based on knowledge. Controller based on knowledge. Reprezentation of knowledge in controller KBC.

Adaptive control systems. Adaptive mechanism. Working estimation. Adaptive control systems of static unit. Self-organization controller. Model based controller.

Optimal control. Dynamic optimal notion. Maximum principal. Technical realisation of optimal control system.

Computer networks. Computer Basics. OSI Model. OSI Model. Local Area Networks. Layer 1 - Electronics and Signals. Layer 1 - Media, Connections, and Collisions. Layer 2 – Concepts. Layer 2 – Technologies. Design and Documentation. Structured Cabling Project. Layer 3 - Routing and

Addressing. Layer 3: Protocols. Layer 4 - The Transport Layer. Layer 5 - The Session Layer. Layer 6 - The Presentation Layer. Layer 7 - The Application Layer.

LEARNING OUTCOMES:

Basic knowledge of advanced control systems and computer networks.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Bubnicki Z.: *Theory and controller algorithms*, PWN, Warszawa, 2002 (in Polish)

[2] Rutkowska D., Piliński M., Rutkowski L.: *Neural networks, genetic algorythms and fuzzy logic systems*, PWN, Warszawa, 1999 (in Polish)

[3] Strzelecki R., Supronowicz H.: *Power factor in alternating current supply systems and improvements methods*, Publishing House of Warsaw Technical University, Warszawa, 2000 (in Polish)

[4] Hingorani N., Gyugyi L.: *Understanding FACTS. Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press, New York, 2000

[5] Song Y., Johns A.: *Flexible AC Transmission Systems (FACTS)*, IEE Power and Energy Series 30, TJ International Ltd, Padstow, Cornwall, 1999

[6] Amato V., Lewis W.: *Cisco Network Academy*, MIKOM, Warszawa, 2001 (in Polish)

[7] Sportack M. A.: *Routing IP – Basic Manual*, MIKOM, Warsaw, 2000 (in Polish)

OPTIONAL READING:

[1] –

DIGITAL INDUSTRIAL NETWORKS

Course code: 06.0-WE-E-CSP-PSW_A7_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr inż. Adam Markowski

Name of lecturer: dr inż. Leszek Furmankiewicz

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Project	30	1		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

The evolution of measuring – controlling systems. The architecture of computer industrial networks. Topology of industrial networks. Transmission media: twisted cable, optical waveguide, electric network, wireless solutions.

Access methods to a medium in industrial networks. Master - Slave, Token-Passing, Token-Ring and CSMA.

Standard communication protocols. Characteristics of standard communication protocols PROFIBUS, MODBUS, FIP, P-NET, CAN, LonWorks and INTERBUS-S.

Industrial Ethernet. Internet technologies in computer industrial networks. Dedicated WWW and FTP servers.

Analysis of communication efficiency and time parameters of selected protocols. Transparency, scalability, time determination in industrial networks.

Industrial network components. Converters, amplifiers, concentrators, nodes, routers, bridges and gates. Integration of industrial networks with local computer networks.

Utility programs for creating intelligent devices operating in industrial network nodes. Node self-configuration methods of an industrial network. Creation and configuration technology for industrial network segments. Communication software. Utility programs for creating information applications in industrial networks .

Integration and management of industrial networks. Methods of industrial network integration.

Industrial network analysers and testers. Properties of industrial networks analysers and testers.

Standards engineering of industrial network environments. Specifics of application areas for particular standards. Elements of industrial network designing.

LEARNING OUTCOMES:

Skills and competences in: creating simple applications for cooperation with measuring converter and executive systems equipped with serial communication interfaces, carrying out an analysis of a given project of a measuring – controlling system with industrial network segments related to the determination of communication properties of such a system, selection of industrial network components for a given industrial facility, the determination of communication properties of a proposed solution.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Mielczarek W.: *Serial digital interfaces*, Helion, Gliwice, 1999 (in Polish)

[2] Nawrocki W.: *Computer measuring systems*. WKŁ, Warszawa 2002 (in Polish)

[3] Sacha K.: *Local Profibus networks.* MIKOM, Warszawa 1998 (in Polish)

[4] Winiecki W.: *The organisation of computer measuring systems.* Oficyna Wydawnicza Politechniki Warszawskiej WPW, Warszawa 1997 (in Polish)

[5] Lesiak P., Świsulski D.: *Examples of computer measuring methods*, Agenda Wydawnicza PAK, Warszawa, 2002 (in Polish)

[6] Nawrocki W.: *Distributed measuring systems*, WKŁ, Warszawa 2006 (in Polish)

OPTIONAL READING:

[1] –

DESIGN AND SYSTEM ANALYSIS

Course code: 06.2-WE-E-PASP-PSW_B8_S2S
Type of course: Optional
Entry requirements: -
Language of instruction: Polish
Director of studies: dr hab. inż. Zbigniew Fedyczak, prof. UZ
Name of lecturer: dr hab. inż. Zbigniew Fedyczak, prof. UZ

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	II	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Introduction. Techno-sphere and their relationship with eco-sphere. General description of the stages leads to satisfy the needs and the designing system analysis of the electrical devices.
Technical needs identification. Original and secondary needs. Awareness of needs. Design and constructing as the needs of technical problem solutions. Criteria of needs.
Object of the technical work and technical means and systems. Composition and product. Attributes and properties of technical systems. A technical mean in process of the needs satisfy. General characteristic of the technical systems. Relation in the technical systems.
Fundamentals of design methodology. Designing methods. Heuristic methods, algorithmic methods. Model idea.
Technical preparation of production. Manufacture conception, design assumption data. Construction documentation. Technology documentation. System analysis and examples of the construction documentation of electrical device. The aims and stages of the technology documentation.
Computer aided of the technical preparation of production. Tools and the computer programs used for accomplishing of construction and technology documentations. Normalization and patent computer data bases.

Management of the production quality. A production as a final acting stage lead to needs satisfy. Production time table and production control in manufacture systems. General description of the production quality systems and computer tools and programs for management aids of production quality.

LEARNING OUTCOMES:

Skills and competence in the frame: designing aspects as an acting stage lead to satisfy the needs by means of the electrical devices and knowledge deals with technical production preparation of these devices.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Klir G.: *General systems theory*. *Development trends.* WNT, Warsaw, 1975 and next editions, (in Polish).
[2] Ditrich J.: *System and construction*. *System i konstrukcja.* WNT, Warsaw, 1985 and next editions, (in Polish).
[3] Witkowski T.: *Decision In enterprise management.* WNT, Warsaw, 2004, (in Polish).
[4] Pająk E.: *Production management.* PWN, Warsaw, 2007, (in Polish).
[5] Jaskólski A.: *AutoCAD 2007/LT+*. PWN, Warsaw 2007 (in Polish).
[6] Jaskólski A.: *Autodesk Inventor 10PL/10+.* PWN, Warszawa 2007, (in Polish).

OPTIONAL READING:

[1] –

EMBEDDED MEASUREMENT SYSTEMS

Course code: 06.0-WE-E-PSW-PSW_B8_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr inż. Janusz Kaczmarek

Name of lecturer: dr inż. Janusz Kaczmarek

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	II	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Fundamentals terms and definition. Methodology of designing embedded systems: division of project tasks on software and hardware, creating technical documentation. Some elements of microprocessor technique. Microprocessors and microcontrollers. Microcontroller architecture. Overview of some microcontroller families. Architecture of DSP floating-point processors. Problems of power-saving in embedded systems. Microprocessor power-saving modes. Interfacing of analog-to-digital and digital-to-analog converters.

Introduction to programming for embedded systems. Integrated programming environments. Low-level and high-level programming languages. Hybrid programming technique. Methods of code optimization.

Applying real-time operating system (RTOS) to design the software for embedded systems with low resources. Basic terms. Principles and aims of applying RTOS systems. Mechanisms of RTOS kernel. Services of peripheral devices. Scalability of RTOS. Examples of commercial and non-commercial RTOS. Advantages of applying RTOS in measurement equipment. Real-time operating systems for microcontroller circuits with battery power supply.

Processing of measurement data in digital systems. Arithmetic and numerical representations for measurement data. Effective fixed-point arithmetic on fractional numbers. Transformations of numbers and conversions of codes. Scaling and calibrating. Display of measurement results.

Implementation of some measurement and control algorithms. Software control procedures for analog-to-digital and digital-to-analog converters. Acquisition and generation signals using interrupts. Sampling methods of *RMS* and frequency measurement. Real-time signals processing with DSP processors.

Embedded systems programming in LabVIEW.

LEARNING OUTCOMES:

Skills and competences in the field of designing the software for embedded systems with emphasis on measurement equipment.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[2] Barney G.C.: *Intelligent Instrumentation. Microprocessor Applications in Measurement and Control* , Prentice Hall, 1988

[3] Tumański S.: *Measuring Technique*, WNT, Warszawa, 2007 (n Polish)

[4] Daca W.: *Microcontrollers form 8- to 32-bits*, Wydawnictwo MIKOM, Warszawa, 2000 (in Polish)

[5] Labrosse J.J.: *Embedded System Building Blocks*, CMP Books, 2000

[6] Dąbrowski A.: *Processing of signals with DSP processors*, Wydawnictwo Politechniki Poznańskiej, Poznań, 1998 (in Polish)

[7] Grabowski J, Koślacz S.: *Fundamentals and usage of programming of microprocessors*, WNT, Warszawa, 1987 (in Polish).

OPTIONAL READING:

[1] –

SELECTED PROBLEMS OF POWER ELECTRONICS

Course code: 06.2-WE-E-WZE-PSW_C9_S2S
Type of course: Optional
Entry requirements: -
Language of instruction: Polish
Director of studies: dr hab inż. Zbigniew Fedyczak, prof. UZ
Name of lecturer: dr hab inż. Zbigniew Fedyczak, prof. UZ

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	II	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Introduction. General description of the problems in the frame of power electronic circuits and new solutions of semiconductor power electronic devices. Analysis methods of the power electronic circuit properties.
PWM AC/DC converters. Topologies, operation description and properties of single- and three-phase buck or boost rectifiers with sinusoidal input current. Control techniques of impulse stabilizators in unity power factor suppliers. Integrated circuits of impulse stabilizators.
PWM AC choppers. Topologies, operation description and properties of single- and three-phase matrix choppers (MC) and matrix-reactance choppers (MRC). Application examples of such converters.
Matrix converters. Properties of the matrix converters: with low frequency transfer matrix control strategy (Venturini and scalar control methods): with space vector and fictitious DC link control strategy. Application examples of such converters.
Matrix-reactance frequency converters. Description of conception of the frequency converters with buck-boost voltage transformation based on matrix-reactance PWM AC choppers. Topologies, operation description and properties of selected solutions.
Multilevel power electronic converters. Concept of multilevel converters. Topologies, operation description and properties of the voltage source inverters. Selected solutions of other multilevel converters and their applications.
Resonance converters. Converters with resonance switch types ZVS, ZCS, quasi- and multiresonance. Converters with resonance load and resonance DC link. Example of selected solutions and their applications.

Galvanic separation in power electronic converters. Galvanic isolation of the signals connected with electrical energy transfer by means of the electromagnetic or piezoelectric couple. Impulse transformer solution. Example of selected solutions and their applications.

Future trends of the power electronic circuits. A new semiconductor power electronic switches and intelligent power modul. Conversion quality improvement as well as new application areas of the power electronic converters.

LEARNING OUTCOMES:

Skills and competence in the frame: operation understanding, analysis and design of selected power electronic converters, knowledge deals with their properties and application fields.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester (part-time studies), obtaining a positive grade in written or oral exam (full-time studies).

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Piróg S.: Power electronics. AGH Publishing House. Cracow, 1998 (in Polish).
[2] Mohan N.: *Power Electronics: Converters, Applications, and Design.* John Wiley & Sons, 1998.
[3] Trzynadlowski A.: *Introduction to modern power electronics*. John Wiley & Sons, 1998.
[4] Mikołajuk K.: Fundamentals of Power electronic circuits analysis. Warsaw, PWN 1998 (in Polish).
[5] Erickson R. W.: Maksimović D.: *Fundamentals of power electronics.* Kluwer Academic Publischers, USA 2001.
[6] Holms D. G., Lipo T. A.: *Pulse width modulation for power converters. Principle and practice*. IEEE press. New York 2003.
[7] Fedyczak Z.: *Impulse alternating voltage transforming circuits.* University of Zielona Gora Publishing House. Zielona Góra 2003 (in Polish).

OPTIONAL READING:

[1] –

ELECTROMAGNETIC COMPATIBILITY

Course code: 06.2-WE-E-KE-PSW_D10_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr hab inż. Adam Kempski, prof. UZ, dr inż. Robert Smoleński

Name of lecturer: dr hab inż. Adam Kempski, prof. UZ, dr inż. Robert Smoleński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	III	Exam	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Introduction to electromagnetic compatibility (EMC). Basic terms. EMC terminology. Immunity and emissions of electric equipment. Interference sources – intentional and non-intentional.

Electromagnetic fields and coupling mechanisms. Near and far field terms. Conducted and radiated interferences. Basic mechanisms of electromagnetic interferences couplings and propagations: galvanic, by means of near and far fields. Propagation of EMI in transmission lines. Basics of EMI signal analysis.

EMC measurement and investigations. Methods of electromagnetic emission measurement. Immunity measurements. Measurements at the development stage.

Electromagnetic compatibility in the electronic equipment. Characteristics of real elements in the interference frequency range. Electromagnetic compatibility of PCB. Signal integrity. EMC of control and transmission systems. EMC of telecommunication systems. EMC and functional safety of electronic equipment.

EMC strategy. EMC analyses and simulations. Techniques of EMI effects reduction – earthing and bonding, shielding, topology and structure of circuits, EMI filters. development of devices according to EMC requirements. Internal and external EMC. EMC for systems and installations.

EMC standardization. International Standardization Organization. Directives of New Approach and Global Approach. EMC Directive. EMC standards. EMC standards classification – generic, basic and product standards. Standards for electromagnetic environments. Safety related EMC standards. Present stage of EMC standardization. Routes to declaring compliance and CE marking and legal responsibility of manufacturer.

Electric power quality. Definitions of power quality. Voltage characteristics of electricity supplied by public distribution systems. Voltage sags or dips, short interruptions, asymmetry and distortions. Methods of improvement of electric power quality. Influence of loads on electric power quality. Measurements of characteristics of electric power quality.

LEARNING OUTCOMES:

Skills and competences in: identifying of the basic mechanisms of couplings and propagation of electromagnetic interferences, electromagnetic emission and immunity measuring methods; application of EMI mitigation techniques; development of devices according to EMC requirements; knowledge of basic EMC legal requirements.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Weston D.A.: *Electromagnetic Compatibility. Principles and Applications*. Marcel Dekker Inc., 1991

[2] Williams T., Armstrong K.: *EMC for systems and Installations*, Newness, 2000

[3] Tichanyi L.: *Electromagnetic Compatibility in Power Electronic*. J.K.Eckert & Company, 1995

[4] Magnusson P.C. et al.: *Transmission lines and wave propagation*, CRC Press, 2001

[5] Charoy A.: *Interferences In electronic devices*, WNT W-wa, 1999 (in Polish).

OPTIONAL READING:

[1] –

INTERNET TECHNOLOGIES

Course code: 11.3-WE-E-TI-PSW_D10_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr inż. Robert Szulim

Name of lecturer: dr inż. Robert Szulim

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	III	Exam	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE CONTENTS:

Primary protocols and services of The Internet. Description of work of protocols: TcpIp, Http, Ftp.
WWW and FTP servers. Description of work of servers, configuration and management.
Client – Server Databases. Description of work, objects and designing of structures of databases.
WWW Technologies. Static and dynamic technologies of designing WWW page review.
The Microsoft .NET technology. Description of basics of work of the technology.
WWW forms. Description of mechanisms of sending data through WWW pages.
Databases and WWW. Study of possibilities of building WWW pages with Access to databases.
Security mechanisms. Description of problem of security of work in WWW network.

LEARNING OUTCOMES:

Skills and competences in: designing of structures of databases, starting and configuring of WWW and FTP servers, designing WWW portals with Access to databases.

ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade in written or oral exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Project – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Ullman Jeffrey D., Widom Jennifer , *Primary lecture of databases,* Wydawnictwo Naukowo Techniczne, Warszawa 2001 (in Polish)

[2] Coburg R, *SQL for everyone*, Helion , 2001 (in Polish)

[3] Pinkoń K., *ABC of the Internet*, Helion, 1998 (in Polish)

[4] Liberty J, Hurwitz D, *ASP.NET programming*, Helion, 2007 (in Polish).

OPTIONAL READING:

[1] –

ENERGY CONVERSIONS AND ALTERNATIVE ENERGY SOURCES

Course code: 06.2-WE-E-PEAŹ-PSW_E11_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr hab inż. Grzegorz Benysek, prof. UZ

Name of lecturer: dr inż. Robert Smoleński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE CONTENTS:

Energy resources and energy demands. Conversion of the thermal energy into mechanical and electrical. Conversion of the wind and water energy. Conversion of the nuclear energy into thermal and electrical energy. Energy conversions and influence onto environment.

Nuclear energy. Nuclear reactor – principle of operation. Advantages and disadvantages of the nuclear power stations.

Wind energy. Wind conditions In Poland and Europe. Wind conversion system. Ecological, scenery and environmental results of the wind installations utilization.

Sun energy. Insolation in Poland. Types and construction of the solar systems. Principle of operation. Examples of the industrial installations with photovoltaic.

Water energy. Turbine construction. Influence of the large water power stations onto environmental changes. Principles of constructions as well as cooperation of the small water power stations with the energy network.

Geothermal energy. Methods and examples of utilization of the geothermal energy. Geothermal energy resources in Poland. Principle of operation of the heat pumps, heat sources utilized In heat pumps. Biogas, biomass and waste heat. Fermentation as source of the biogas. Straw and brushwood utilization.

Electrical arrangements In alternative energy sources. Methods of solar energy conversion into electrical energy. Arrangements to cooperation with AC networks.

Novel sources of the alternative energies. Electrolysis and hydrogen utilization. Thermonuclear fusion. Financial aspects of the alternative energy installations.

LEARNING OUTCOMES:

Skills and competences in: understanding and projecting solar systems, photovoltaic systems as well as fuel cells; understanding power electronics coupling systems.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Klugmann E., Klugmann-Radziemska E.: *Alternative energy sources. Photovoltaics power systems*, Wydawnictwo Ekonomia i Środowisko, Białystok, 1999. (in Polish)

[2] Heier S., Waddington R.: *Grid integration of wind energy conversion systems*, John Wiley & Sons, 2006.

[3] Luque A.: *Handbook of photovoltaic science and engineering*, John Wiley & Sons, 2003.

[4] O'Hayre R.: *Fuel cell fundamentals*, John Wiley & Sons, 2006.

[5] Lewandowski W.: *Ecological friendly renewable energy sources*, WNT, Warszawa, 2001. (in Polish)

[6] Marecki J.: *Basic of energy transformations*, WNT, Warszawa, 1995. (in Polish).

OPTIONAL READING:

[1] –

DIGITAL SIGNAL PROCESSING

Course code: 06.0-WE-E-CPS-PSW_E11_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr hab inż. Ryszard Rybski

Name of lecturer: dr hab inż. Ryszard Rybski , dr inż. Mirosław Kozioł

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE CONTENTS:

Introduction. Applications of digital signal processing (DSP). DSP advantages and disadvantages.

Fundamentals of signal theory. Notion of signal. Classifications of signals: analog, discrete and digital signals, deterministic and random signals. Mathematical models of selected signals.

Fourier series and Fourier transform for continuous time signals. Fourier series representation of continuous-time signals with examples. Synthesis of continuous-time signals on the basis of the Fourier coefficients. Gibbs phenomenon. Dirichlet conditions of the Fourier series representation of signals. Fourier series properties. The Fourier transform. Dirichlet conditions for Fourier transform. Fourier transform properties. An influence of a signal observation in finite time interval on its spectrum.

Analog-to-digital and digital-to-analog conversion. Path of analog-to-digital and digital-to-analog processing of continuous-time signals. Sampling, quantization and coding. Quantization error. Signal-to-noise ratio. Sampling theorem. Spectrum of a sampled signal. Aliasing. Anti-aliasing filter. Recovery of an analog signal.

Discrete Fourier transform (DFT). Derivation of Fourier transform for discrete-time signals. DFT properties. Derivation of amplitude and phase spectrum. Leakage. Parametric and non-parametric spectral windows. Spectrum resolution improvement by zero padding. Examples of spectral analysis of discrete-time signals and their interpretation.

Fast Fourier transform (FFT). Basic butterfly computation in radix-2 FFT algorithm. Computational profit. Different aspects of practical implementation of radix-2 FFT. Computation of inverse DFT using FFT. Real-valued FFT.

Linear causal time-invariant systems. Definitions of discrete, linear and time-invariant system. Convolution. Stability of LTI systems in BIBO sense. Causal systems. Difference equation.

Z-transform. The *z*-transform definition. Region of convergence for *z*-transform. The inverse *z*-transform and methods of its evaluation. *Z*-transform properties. The transfer function. Poles and zeros of transfer function. Pole locus and stability of system.

Digital filters. Finite and infinite impulse response systems. Processing discrete-time signals by digital filters. Basic structures of filters. Determination and interpretation of the frequency response of digital filters. An influence of zeroes and poles locus on the system frequency response. Filters with linear phase response. Group delay.

IIR digital filter design. Bilinear transformation method.

FIR digital filter design. Method based on windowed Fourier series.

Simulation of continuous-time systems by discrete-time systems. Comparison of mathematical description of continuous-time and discrete-time systems. Approximation of derivatives in differential equation by differences. Simulation by bilinear transform.

Convolution and deconvolution. Linear and circular convolution. Convolution in frequency domain. Block convolution. Deconvolution in frequency and *z*-transform domain. Inverse systems.

LEARNING OUTCOMES:

Skills and competences: theoretical background of analog-to-digital and digital-to-analog processing, transform analysis of linear time-invariant systems, spectrum analysis of discrete-time signals, mathematical description of discrete-time systems, implementation of digital filtering, digital filter design.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Izydorczyk J., Konopacki J.: *Analog and digital filters*, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice, 2003 (in Polish)

[2] Lyons R.G.: *Understanding Digital Signal Processing*, Prentice Hall, 2004

[3] Mitra S.: *Digital Signal Processing: A Computer-Based Approach*, McGraw-Hill, 2005

[4] Oppenheim A.V., Schafer R.W., Buck J.R.: *Discrete-Time Signal Processing*, Prentice Hall, 1999

[5] Oppenheim A.V., Willsky A.S., Nawab H.: *Signals & Systems*, Prentice Hall, 1997

[6] Smith S.W.: *Digital Signal Processing: A Practical Guide for Engineers and Scientists*, Newnes, 2002

[7] Szabatin, J.: *Fundamentals of signals theory*, WKŁ, Warsaw, 2003 (in Polish)

[8] Zieliński T.P.: *Digital signal processing: From theory to applications*, WKŁ, Warszawa, 2005 (in Polish).

OPTIONAL READING:

[1] –

ADVANCED SYSTEMS FOR POWER FLOW CONTROL

Course code: 06.2-WE-E-ZSPE-PSW_F12_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr hab inż. Grzegorz Benysek, prof. UZ

Name of lecturer: dr hab inż. Grzegorz Benysek, prof. UZ

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE CONTENTS:

Distributed generation. Power quality in distributed electrical power system. Limitations of the transmission and distributed power lines.

Control of the parameters of the electrical power system. Series, parallel and series-parallel compensation. Power electronics arrangements for compensation.

Electrical power system - stability. Transient and dynamic stability. Methods of improvement of the stability margin. Influence of the series, parallel and series-parallel compensation on transient and dynamic stability.

Conventional FACTS. Knowledge of TCR, TSC, SVC, TCSC, FC. Influence of the above mentioned on system stability.

FACTS on the base of synchronous sources. Knowledge of SSSC, STATCOM, UPFC, IPFC. Influence of the above mentioned on system stability.

Energy storage arrangements. Batteries. Super-capacitors. Compressed air. Fly wheels. Fuel cells. SMES. FACTS with energy storage – influence on voltage conditions and stability.

UPS arrangements. UPS Standby. UPS Line-interactive. Delta conversion UPS.

Methods for identification of the unneeded components. Basic component identification method. Integral methods. Instantaneous power theory. Kalman filters. Neural networks. DTF.

Power electronics arrangements for power quality improvement. Series and parallel active filters. Hybrid filters. Series-parallel arrangements for power quality improvement – UPQC. UPLC arrangements.

LEARNING OUTCOMES:

Skills and competences in: understanding and designing power electronics arrangements to power flow control.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Strzelecki R., Supronowicz H.: *Power factor in alternating currents systems and improvement methods*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2000. (in Polish)

[2] Hingorani N., Gyugyi L.: *Understanding FACTS. Concepts and technology of flexible AC transmission systems*, IEEE Press, New York, 2000.

[3] Song Y., Johns A.: Flexible AC transmission systems (FACTS), IEE Power and Energy Series 30, TJ International Ltd, Padstow, Cornwall, 1999.

[4] Benysek G.: Improvement in the quality of delivery of electrical energy using power electronics systems, Springer-Verlag Ltd, London, 2007.

OPTIONAL READING:

[1] –

MATHEMATICAL MODELING OF MEASUREMENT TRANSDUCERS

Course code: 06.0-WE-E-MPP-PSW_F12_S2S

Type of course: Optional

Entry requirements: -

Language of instruction: Polish

Director of studies: dr hab inż. Wiesław Miczulski, prof. UZ

Name of lecturer: dr hab inż. Wiesław Miczulski, prof. UZ

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE CONTENTS:

General characteristic of intelligent metrology transducers. Characteristic of basic functional intelligent measurement transducers blocks. Features distinguishing intelligent measurement transducers from previous generation transducers.

General notes about designing and role of mathematical model. The aim and stages of the design process. Sequential-iteration design algorithm. Limitations in the process of designing. Essence and scope of the mathematical modelling.

Fundamentals of models building. Stages of mathematical modelling. Analogies between physical phenomena's. Methods of creation of mathematical models. Examples of building sensor models and analogue digital devices.

Primary transducers elements and their mathematical models. Mathematical models of input circuits, analogue function modules, sample-and-hold and analogue digital.

Rules of designing of metrological transducers with analogue function operators. Transducer of active power and root mean square voltage.

Rules of designing of metrological transducers with sample transducers. Transducer of active power.

Selected methods of error correction of metrological transducers. General notes about methods of error correction. Selected correction procedures. Iteration methods. Sample source method. Test methods. Adaptation of parameters of measurement circuit to parameters of transduced signals and work conditions. Multi parameter methods. Selected examples of intelligent sensors and transducers.

LEARNING OUTCOMES:

Skills and competences in: designing, modeling and simulation of metrological characteristics of metrological transducers, applying error correction procedures.

ASSESSMENT CRITERIA:

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

RECOMMENDED READING:

[1] Barzykowski J. (red.): Contemporary metrology. Selected subjects., WNT, Warszawa, 2004 (in Polish)

[2] Bolikowski J. (red): Essentials of designing of intelligent measurement transducers of electrical quantities, Monograph Nr 68, WSI, Zielona Góra 1993 (in Polish)

[3] Gajda J., Szyper M.: *Modelling and simulation research of measurement systems*, Jartek s.c.. Kraków 1998 (in Polish)

[4] Jakubiec J., Roj J.: Measurement sample transducers, Wydawnictwo Politechniki Śląskiej, Gliwice, 2000 (in Polish)

[5] Rak R.: Virtual measurement instrument – real tool of contemporary metrology, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2003 (in Polish).

OPTIONAL READING:

[1] –