AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Signals and Systems

Academic year: 2019/2020 Code: IETE-1-302-s ECTS credits: 4

Faculty of: Computer Science, Electronics and Telecommunications

Field of study: Electronics and Telecommunications Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 3

Course homepage: —

Responsible teacher: prof. dr hab. inż. Papir Zdzisław (papir@agh.edu.pl)

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	Student is able to consider and solve problems in a creative manner.	ETE1A_K01	Project
Skills: he can			
M_U001	Student is able to perform literature, databases and other sources research; student can integrate, analyze and comment researched results. Student is prepared to formulate conclusions and opinions.	ETE1A_U02	Project
M_U002	Student can deploy mathematical methods, models, and computer simulations for analysis and assessment of performance of telecommunication network and data processing systems elements.	ETE1A_U06	Project
Knowledge: he knows and understands			
M_W001	Student gets an extended knowledge in mathgematical analysis and probabilistic necessary for analysis and modelling of ssgnals and linera systems.	ETE1A_W01	Examination, Test
M_W002	Student knows and understands methods for telecommunication signals representation in both time and frequency domain. Student knows principles of analogue transmission, properties of telecommunication channel, transmission codes and modulations.	ETE1A_W14	Examination, Test

Number of hours for each form of classes

Suma	Form of classes										
	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
48	24	24	0	0	0	0	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	Student is able to consider and solve problems in a creative manner.	-	+	-	-	-	-	-	-	-	-	-
Skills: he can												
M_U001	Student is able to perform literature, databases and other sources research; student can integrate, analyze and comment researched results. Student is prepared to formulate conclusions and opinions.	+	+	-	-	-	-	-	-	-	-	-
M_U002	Student can deploy mathematical methods, models, and computer simulations for analysis and assessment of performance of telecommunication network and data processing systems elements.	-	+	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student gets an extended knowledge in mathgematical analysis and probabilistic necessary for analysis and modelling of ssgnals and linera systems.	+	+	-	-	-	-	-	-	-	-	-

M_W002	Student knows and understands methods for telecommunication signals representation in both time and frequency domain. Student knows principles of analogue transmission, properties of telecommunication channel, transmission codes and modulations.	+	+	-	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	48 h
Preparation for classes	16 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	10 h
Realization of independently performed tasks	46 h
Summary student workload	120 h
Module ECTS credits	4 ECTS

Additional information

Module content

Lectures

LECTURES
1.Signals and linear systems (3 h)
Introduction to the lecture. Signal theory problems. Taxonomy of signals and systems. Signals parameters. Time-invariant, linear, lumped systems (TILS). Invariant to TILS. Concept of a system transfer function. Concept of an exponential Fourier series.
2.Time-invariant, linear, lumped systems in the time domain (3 h)
Time-invariant, linear systems with a continuous time. Input-output equations. Initial conditions. Transient and steady state response. Stationary state.
3.RLC networks as time-invariant, linear, systems (3 h)
Properties of R, L, C elements. Basic RLC structures. Transfer functions (impedance, admittance) of R, L, C elements. Kirchoff equations. From Kirchoff equations to input-output equations.
4.Fourier series (3 h)
Exponential and trigonometrical Fourier series. Amplitude and phase spectrum. Fourier series properties and restrictions.
5.Fourier transform (3 h)
From Fourier series to Fourier transform. Fourier trans form properties. Examples of Fourier trans form pairs.
6.Dirac Distribution (3 h)
Concept of Dirac distribution. Properties of Dirac distribution. Comb distribution. Signal sampling. Filtration of signals in TILS in the time and frequency domain. Transfer function. Comvolution integraf. Impulse response of a filter.
7.Filtration of signals (3 h)

Taxonomy of filters. Ideal lowpass filter. Synthesis of filters. A-f and p-f characteristics. Decibel and decade. Bode plots. Asymptotical Bode plots. Sampling Thorem. Bandpass filtering.
8.Laplace and Hilbert transforms (3 h)
Concept of the Laplace trans form. Applications of Laplace trans form. Definition of Hilbert transform. Properties of Hilbert trans form. Analytical signal. Lowpass representation of narrowband, band pass signals.
9.Modulation system. Amplitude modulations (3 h)
Modulation concept. Purpose of modulation. Modulation taxonomy. Modulation system diagram. DSB-SC modulation. AM modulation. Coherent and enevelope detection. SSB-SC modulation. VSB-SC modulation.
10.Phase angle modulations (3 h)
PM modulation. FM modulation. Relations between PM and FM modulations. Narrowband frequency modulation (NBFM). Wideband frequency modulation (WBFM). Carson’s rule for a FM bandwidth.
11.Channel noise in modulations systems (3 h)
Sources of channel noise in modulation systems. Lowpass representation of a narrowband noise. Power den sity spectrum. Signal to noise ratio (SNR). Modulation gain. Noise characteristics of modulation system.
12.Noise characteristics of some modulation systems (3 h)
Modulation systems DSB-SC, AM, SSB-SC. Threshold effect. Modulation system FM. Threshold effect. Bandwidth – SNRE tradeoff in FM systems. Comparison of amplitude and frequency modulation systems.
13.Pulse modulations and transmission codes (3 h)
Modulations PAM, PPM, PFM, PDM. Konsekwencje odstępstw od założeń twierdzenia o próbkowaniu. Idea of a transmission code. Transmission code properties. Intersymbol Interference (ISI). Kryterium Nyquist criterion for ISI-less transmission.
14.Pulse Code Modulation (PCM) (3 h)
Signal quantization. Arithmetical coding. PCM modulation. Quantization noise. Optimizations of quantizer static characteristics. DPCM modulation.
15.Power properties of signals (3 h)
Definition of Power and energy of signals. Parseval Thorem. Energy (Power) spectrum. Autocorrelation function. Power spectrum of random signals. Chinczyn thorem.

Signal Tehory lectures are devoted to two areas: 1. Spectral analysis of signals, 2. Transmission of signals in linear, time-invariant models in both time and frequency domain, 3. Analogue modulations, and 4. Modulation systems in a noisy environment. All theorethical issus are illustrated with telecommunication applications.

Auditorium classes

Signal Theory classes are carried strictly correspond to successive lectures. Content of the classes extends the knowledge taught in lectures, in particular, teach the practical use of the methods and models provided during the lectures. The classes consist of both theoretical and practical parts. In the theoretical part calculations related to the analyzed methods and models are examined, while in the practical part simulation studies related to calculations are performed.

Teaching methods and techniques:

Lectures: Treści prezentowane na wykładzie są przekazywane w formie prezentacji multimedialnej w połączeniu z klasycznym wykładem tablicowym wzbogaconymi o pokazy odnoszące się do prezentowanych zagadnień.

Auditorium classes: Podczas zajęć audytoryjnych studenci na tablicy rozwiązują zadane wcześniej problemy. Prowadzący na bieżąco dokonuje stosowanych wyjaśnień i moderuje dyskusję z grupą nad danym problemem.

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

Nie określono

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: No
– Participation rules in classes: Studenci uczestniczą w zajęciach poznając kolejne treści nauczania zgodnie z syllabusem przedmiotu. Studenci winni na bieżąco zadawać pytania i wyjaśniać wątpliwości. Rejestracja audiowizualna wykładu wymaga zgody prowadzącego.
Auditorium classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Studenci przystępując do ćwiczeń są zobowiązani do przygotowania się w zakresie wskazanym każdorazowo przez prowadzącego (np. w formie zestawów zadań). Ocena pracy studenta może bazować na wypowiedziach ustnych lub pisemnych w formie kolokwium, co zgodnie z regulaminem studiów AGH przekłada się na ocenę końcową z tej formy zajęć.

Method of calculating the final grade

1.Aby uzyskać pozytywną ocenę końcową niezbędne jest uzyskanie pozytywnej oceny z zajęć laboratoryjnych oraz zdanie egzaminu. Warunkiem dopuszczenia do egzaminu jest posiadanie oceny pozytywnej z zajęć laboratoryjnych.
2.Obliczamy średnią ważoną z ocen z zajęć laboratoryjnych (50%) i egzaminu (50%) uzyskanych we wszystkich terminach.
3.Wyznaczamy ocenę końcową na podstawie zależności:
if sr>4.75 then OK:=5.0 else
if sr>4.25 then OK:=4.5 else
if sr>3.75 then OK:=4.0 else
if sr>3.25 then OK:=3.5 else OK:=3

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Nie określono

Prerequisites and additional requirements

Prerequisites:
1. Algebra and analysis
2. Probability calculus

Recommended literature and teaching resources

1. J. Szabatin: Podstawy teorii sygnałów. WKiŁ, Warszawa 2004.
2. J. M. Wojciechowski: Sygnały i systemy. WKiŁ, Warszawa 2008.
3. M. Kantor, Z. Papir: Modulacja i detekcja – zbiór zadań z rozwiązaniami. UWND AGH, Kraków 2008.
4. Z. Papir: Analiza częstotliwościowa sygnałów. UWND AGH, Kraków 1995.
5. Z. Papir: Modulacja i detekcja. UWND AGH, Kraków 1992.
6. R. E. Ziemer, W. H. Tranter: Principles of Communications – Systems, Modulations, and Noise, John Wiley 2010.
7. H. Baher: Analog and Digital Signal Processing, John Wiley 2001.

Scientific publications of module course instructors related to the topic of the module

“Obiektywne pomiary jakości sekwencji wizyjnych”
M. Grega, L. Janowski, M. Leszczuk, Z. Papir, “Cyfrowe przetwarzanie sygnałów w telekomunikacji : podstawy – multimedia – transmisja”, red. nauk.: T. P. Zieliński, P. Korohoda, R. Rumian, PWN, 2014, s. 740-766.

“Video quality assessment: subjective testing of entertainment scenes”
M. H. Pinson, L. Janowski, Z. Papir, IEEE Signal Processing Magazine, 2015 vol. 32 no. 1, s. 101–114.

Additional information

None