AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Circuits Theory 2

Academic year: 2019/2020 Code: IETE-1-204-s ECTS credits: 5

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: 2

Course homepage: —

Responsible teacher: dr inż. Rydosz Artur (rydosz@agh.edu.pl)

Module summary

Student possesses systematic knowledge in the field of electric circuits theory, including periodic and transient states in linear electric circuits.

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 understands the need for constant development and upgrading his/her professional skills.	ETE1A_K01	Activity during classes
M_K002	Student is aware of the importance of professional ethics and respect for variety of beliefs and cultures.	ETE1A_K03	Activity during classes
Skills: he can			
M_U001	Student can use known methods and mathematical models in analysis of electrical and electronic circuits.	ETE1A_U06	Examination, Test
M_U002	Student can both analyze and synthesize simple signal processing circuits in time and frequency domain.	ETE1A_U07	Examination, Test

M_U003	Student can evaluate the usability of methods and tools applied for solving of simple engineer tasks and to choose and use the proper methods and tools for analysis and synthesize the electronic circuits in DC/AC states.	ETE1A_U10	Examination, Test
M_U004	Student can design a simple electrical circuit and analyze it, eg low-pass / high-pass filter.	ETE1A_U02, ETE1A_U04, ETE1A_U03	Project
Knowledge: he knows and understands			
M_W001	Student understands the basic theorems and has thorough knowledge in the field of electric circuits theory.	ETE1A_W07	Examination, Test
M_W002	Student knows mathematical methods necessary in description and analysis of electric circuits performance, such as complex numbers, derivatives, integrals.	ETE1A_W01	Examination, Test

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
48	20	14	14	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 understands the need for constant development and upgrading his/her professional skills.	+	+	+	-	-	-	-	-	-	-	-
M_K002	Student is aware of the importance of professional ethics and respect for variety of beliefs and cultures.	+	+	+	-	-	-	-	-	-	-	-
Skills: he can												

M_U001	Student can use known methods and mathematical models in analysis of electrical and electronic circuits.	+	+	+	-	-	-	-	-	-	-	-
M_U002	Student can both analyze and synthesize simple signal processing circuits in time and frequency domain.	+	+	+	-	-	-	-	-	-	-	-
M_U003	Student can evaluate the usability of methods and tools applied for solving of simple engineer tasks and to choose and use the proper methods and tools for analysis and synthesize the electronic circuits in DC/AC states.	+	+	+	-	-	-	-	-	-	-	-
M_U004	Student can design a simple electrical circuit and analyze it, eg low-pass / high-pass filter.	-	-	-	-	-	-	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student understands the basic theorems and has thorough knowledge in the field of electric circuits theory.	+	+	+	-	-	-	-	-	-	-	-
M_W002	Student knows mathematical methods necessary in description and analysis of electric circuits performance, such as complex numbers, derivatives, integrals.	+	+	+	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	48 h
Preparation for classes	26 h
Realization of independently performed tasks	51 h
Summary student workload	125 h
Module ECTS credits	5 ECTS

Additional information

Module content

Lectures

Classes in a form of lecture (30 h) and recitiation classes (30 h)

Lectures

1. Periodic current circuits (4h)

Transforming periodic signal into the Fourier series. Spectrum of a periodic signal. Analysis of the periodic current circuits. Power in periodic current circuits.

2. Transient states in linear electric circuits (6h)

Commutation. Transient states in first order circuits. Transient states in circuits of higher order. Classic method of first order circuits analysis. Laplace’s transform. Operational method of transient states analysis. Impedance and admitance of two-port. Elements equations in operational domain. Dirac distribution. Electric circuits description using state equations. State equations solving in time domain and in complex domain.

3. Four-ports (6h)

Terminal equations of four-port. Matrix notation of four-port equations. Characteristic parameters interpretation. Equivalent schematic diagrams of four-port. Four-port working parameters. Reciprocal four-ports. Symmetrical four-ports. Four-ports having three-port structure. Four-ports connection. Wave description of four-port.

4. Transmission properties of linear circuits (6h)

Four-port as a transmission circuit. Transfer function. Characteristics in time domain. Transmission circuit stability. Stability criteria. Characteristics in frequency domain. Asymptotic characteristics. Approximation: Butterworth’s approximation and Chebyschev’s approximation.

5. Nonlinear circuits (4)

Analysis methods of nolinear resistive direct current circuits. Nonlinear elements in periodic current circuits.
Small-signal analysis. Transient analysis of nonlinear-circuits.

6. Transmission lines (4)

Transmission line equations. Description of a transmission line in sinusoidal steady-state. Wave parameters of transmission line. Transmission line analysis with arbitrary excitation.

Auditorium classes

Recitation classes

Transforming exemplary periodic signals into Fourier series. Examples of periodic current circuits. Transient analysis of the first order circuits with the use of classic method. Transient analysis using operatorial method. Computing of four-ports characteristic matrices and wave parameters. Determining of transfer function, characterisitics in time and frequency domain and examining of simple transmission circuits stability. Nolinear resistive circuits analysis. Dynamic state analysis of nonlinear circuits. Analysis of circuits with transmission lines.

Laboratory classes

Laboratory will cover several topics:

1. Experimental verification of AC circuits with sinusoidal excitation. Vector measurements of currents and voltages in circuits for examining the known methods of circuits analysis.

2. Examination of RLC circuits under impulse excitation. Circuits measurements: differentiator, integrator, resonator. Observation of the second order response for different values of characteristic resistance.

3. Measurements of two-port parameters of the chosen two-port networks and their connections: series, parallel and cascade.

4. Measurements of spectra of periodical signals. Determining spectra on the basis of the time domain measurements.

5. Measurements of frequency characteristics of basic circuits. Calculation and experimental verification of the transfer function for chosen circuits: differentiator, integrator, resonator and complex two-ports.

6. Verifying the project solutions: simulations results or hardware developments, e.g. filter design, frequency mixers, power/current/voltage dividers, amplifiers.

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.
Laboratory classes: W trakcie zajęć laboratoryjnych studenci samodzielnie rozwiązują zadany problem praktyczny, dobierając odpowiednie narzędzia. Prowadzący stymuluje grupę do refleksji nad problemem, tak by otrzymane wyniki miały wysoką wartość merytoryczną.

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.
Laboratory classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Studenci wykonują ćwiczenia laboratoryjne zgodnie z materiałami

udostępnionymi przez prowadzącego. Student jest zobowiązany do przygotowania się w przedmiocie wykonywanego ćwiczenia, co może zostać zweryfikowane kolokwium w formie ustnej lub pisemnej. Zaliczenie zajęć odbywa się na podstawie zaprezentowania rozwiązania postawionego problemu. Zaliczenie modułu jest możliwe po zaliczeniu wszystkich zajęć laboratoryjnych.

Method of calculating the final grade

1. The requirement for receiving positive final note is receiving of positive note from examination.

2. Final note is computed as an average value of notes received from all examinations that student has entered.

If the average note is equal to 2.0, student receives 2.0 as a final note.

If the average note is in interval (2.0, 3.0], student receives 3.0 as a final note.

If the average note is in interval (3.0, 3.5], student receives 3.5 as a final note.

If the average note is in interval (3.5, 4.0], student receives 4.0 as a final note.

If the average note is in interval (4.0, 4.5], student receives 4.5 as a final note.

3. The requirement for examination entering is receiving positive note from recitation classes.

4. Note from recitation classes is given on the basis of written tests, which verify student’s ability of solving the tasks presented in lectures and recitation classes.

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

Nie określono

Prerequisites and additional requirements

Knowledge of linear direct and sinusoidal current circuits analysis methods. Usefull basic informations related to Fourier series, Laplace’s transform, Fourier transform and differential equations

Recommended literature and teaching resources

Rutkowski J. Circuits Theory, Silesian University of Technology, Gliwice 2006
Osiowski J., Szabatin J.: Podstawy teorii obwodów, tom 1-3, WNT, Warszawa 2001.
Bolkowski S.: Teoria obwodów elektrycznych, WNT, Warszawa 2009.
Osowski S., Siwek K., Śmiałek M.: Teoria obwodów, Oficyna Wydawnicza Politechniki Warszawskiej, 2006.
Chua L.O., Desoer C.A., Kuh E.S.: Linear and nonlinear circuits, Mc Grew-Hill, New York, 1987.
John Birds, Electrical Circuit Theory and Technology
Omar Wing, Classical Circuit Theory
Basic circuit theory / Charles A. Desoer and Ernest S. Kuh, New York : McGraw-Hill Book Company, 1969.

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

1. Three-beam microstrip antenna arrays fed by 3 × 3 Butler matrix / Izabela SŁOMIAN, Artur RYDOSZ, Sławomir GRUSZCZYŃSKI, Krzysztof WINCZA // W: MAPE 2017 : 7th IEEE international symposium on Microwave, Antenna, Propagation, and EMC technologies : 24-27 October, Xi’an, China / ed. Yinghong Wen. — [Piscataway] : IEEE, cop. 2017. — W WoS ISBN: 978-1-5090-5929-4. — ISBN: 978-1-5090-5928-7. — S. 9–12. — Bibliogr. s. 12, Abstr.. — tekst: https://goo.gl/s8Sb1z
2. Six-port microwave system for volatile organic compounds detection / Kamil STASZEK, Artur RYDOSZ, Erwin Maciak, Krzysztof WINCZA, Sławomir GRUSZCZYŃSKI // Sensors and Actuators ; ISSN 0925-4005. B. Chemical ; ISSN 0925-4005. — 2017 vol. 245, s. 882–894. — Bibliogr. s. 892–894, Abstr.. — Publikacja dostępna online od: 2017-02-06. — tekst: https://goo.gl/M6X6YW

3. Układ pomiarowy matrycy rezystywnych sensorów gazu — [Measurement system for resistive metal oxide sensors matrix] / Piotr Róg, Artur RYDOSZ, Andrzej BRUDNIK // W: ELTE'2016 : technologia elektronowa : XII konferencja naukowa : Wisła, 11–14 września 2016 : program konferencji. — [Polska : s.n.], [2016]. — S. 23. — Pełny tekst na dysku Flash. — S. [1–2]. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. [2]. — Afiliacja autorów: Akademia Górniczo-Hutnicza
4. Two-dimensional beamwidth broadening of microstrip antenna arrays / Izabela SŁOMIAN, Sławomir GRUSZCZYŃSKI, Krzysztof WINCZA, Artur RYDOSZ // W: AP-S/URSI 2016 [Dokument elektroniczny] : IEEE AP-S symposium on Antennas and Propagation and URSI CNC/USNC joint meeting : June 26–July 1, 2016, Fajardo, Puerto Rico. — Wersja do Windows. — Dane tekstowe. — [Piscataway] : IEEE, cop. 2016. — Dysk Flash. — Dod. e-ISBN: 978-1-5090-2851-1 ; w WoS ISBN: 978-1-5090-2886-3. — e-ISBN: 978-1-5090-2885-6. — S. 905–906. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. 906, Abstr.. — Publ. w cz.: AP-S Paper
5. Suspended-strip-coaxial line impedance-transforming directional coupler / Sławomir GRUSZCZYŃSKI, Artur RYDOSZ, Krzysztof WINCZA // W: 2016 IEEE ANDESCON [Dokument elektroniczny] : Arequipa, Peru, 19–21 October 2016 : proceedings / ed. by IEEE Peru Section. — Wersja do Windows. — Dane tekstowe. — Piscataway : IEEE, cop. 2016. — Dod. ISBN 978-1-590-2532-9. — e-ISBN: 978-1-5090-2531-2. — S. [1–4]. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. [4], Abstr.. — Publikacja dostępna online od: 2017-02-02. — tekst: https://goo.gl/9xQZXK
6. Octave-band aperture-stakced microstrip antenna element for wideband antenna arrays / Krzysztof WINCZA, Sławomir GRUSZCZYŃSKI, Artur RYDOSZ, Izabela SŁOMIAN // W: AP-S/URSI 2016 [Dokument elektroniczny] : IEEE AP-S symposium on Antennas and Propagation and URSI CNC/USNC joint meeting : June 26–July 1, 2016, Fajardo, Puerto Rico. — Wersja do Windows. — Dane tekstowe. — [Piscataway] : IEEE, cop. 2016. — Dysk Flash. — Dod. e-ISBN: 978-1-5090-2851-1 ; w WoS ISBN: 978-1-5090-2886-3. — e-ISBN: 978-1-5090-2885-6. — S. 1579–1580. — Wymagania systemowe: Adobe Reader. — Bibliogr. s. 1580, Abstr.. — Publ. w cz.: AP-S Paper

Additional information

The student can use the learned methods and theorems in other classes, i.e. Electronic Devices, Electronic Metrology.

Classes are conducted using innovative teaching methods developed during 2017-2019 in the POWR.03.04.00-00-D002/16 project, carried out by the Faculty of Computer Science, Electronics and Telecommunications under the Smart Growth Operational Programme 2014-2020

The staff has improved communications skills, which have been developed during English language trainings in the POWR.03.04.00-00-D002/16 project, carried out by the Faculty of Computer Science, Electronics and Telecommunications under the Smart Growth Operational Programme 2014-2020.