

Code	IV.2.
Course Title (English)	Electrical Design
Course Title (Polish)	Podstawy elektrotechniki i elektroniki
Credits	4 ECTS

Language of instruction **English**

Compulsory for Profile: Computer Modelling and Simulation (CMS), Intelligent Energy (IE), Biotechnology for Environmental Protection (BI), Business and Technology (BT)

Type of studies BSc studies

Unit running the programme Electrotechnics and Automatic Control Division at Institute of Environmental Engineering

Course coordinator and academic teacher **Zygmunt Piątek, professor**

Form of classes and number of hours

Semester	Lec.	Tut.	Lab.	Proj.	Sem.	Credit points
IV	30	-	15			4

Learning outcomes The introduction to theory of circuits: DC currents, AC currents, Laplace transform

Prerequisites (mathematical tools) Physical phenomena, solving systems of linear equations, complex numbers, theory of complex function

Course description LECTURE

1. Introduction and basic ideas

Charge, current and voltage
 Energy and power
 Current and voltage sources
 Resistance
 Ohm's law

2. Kirchhoff's laws and series-parallel resistive circuits

Loops, branches and nodes
 Kirchhoff's laws
 Single-loop circuits
 Series and parallel resistance
 Voltage and current division

3. Dependent sources and operational amplifier

Dependent voltage and current sources

Operational amplifier

Virtual short circuit

A/D converter

4. Node and loop analysis

Nodal analysis

Loop analysis

5. Network theorems

Superposition

Source transformations

Thévenin's and Norton's theorems

The maximum power transfer theorem

6. Basic non-linear elements

Non-linear elements

Ideal diode

Simple circuits containing ideal diodes

Zener diodes

Static and dynamic resistance

7. Inductors and capacitors

The inductor

The capacitor

Series and parallel inductors

Series and parallel capacitors

Smoothing properties of a capacitor and a coil

8. Phasors

A brief review of complex numbers

Phasor representatives of sinusoidal signals

Kirchhoff's laws with phasors

Phasor relationships for resistors, inductors and capacitors

Phasor impedance and admittance

9. Sinusoidal steady-state analysis by phasor method

Steady-state circuit analysis using phasors

The phasor diagram

Resonance in series and parallel RLC

Loop and nodal analysis

10. Sinusoidal steady-state power calculations

Instantaneous and average power
Root mean square
Apparent power and power factor
Reactive power
Complex power and conservation of power
Power factor improving
The maximum power transfer in sinusoidal steady-state

11. Balanced three-phase circuits

Three-phase circuits
Y and Δ connections
Types of three-phase connections
Analysis of balanced Y-Y circuit
Analysis of balanced Y- Δ circuit
Power

12. Transient states in first and second-order linear circuits

Mathematical preliminaries
Continuity of energy and its consequences
Transient state in series RL and RC linear circuit
Transient state in series RLC linear circuit

13. The Laplace transform

Definition of Laplace transform
Overview of Laplace transform analysis
Transforms of basic signals
Elementary properties of Laplace transform

14. The inverse Laplace transform

Inverse Laplace transform
Zeros and poles
Partial fraction expansion
Residuals
Typical transforms and their inverse transforms

15. Transient state analysis with Laplace transform

Equivalent circuits for coils and capacitors
Impedance and admittance
Transient state analysis

TUTORIALS AIM (15 hours): Circuit analysis (DC, AC, Laplace transform) according to the lecture programme.

LABORATORY (15 hours): 5 labs

Form of assessment Written assessment - 1 hour (5 problems)

Basic reference materials a) Lectures and hand notes.
b) Raymond A. DeCarlo, Pen-Min Lin, **Linear circuit analysis**, Prentice Hall, Englewood Cliffs, New Jersey 1995.

Other reference materials a) Syed A. Nasar, **3000 solved problems in electrical circuits**, Schaum's Solved Problems Series, McGraw-Hill, 1988.
b) Charles Alexander, Matthew Sadiku, **Fundamentals of electric circuits**, McGraw-Hill, 2008.
c) David McMahan, **Circuit analysis demystified**, McGraw-Hill, 2007.
d) William H. Hayt, Jack Kemmerly, Steven M. Durbin, **Engineering circuit analysis**, McGraw-Hill, 2007.
e) Mahmood Nahvi, Joseph A. Edminister, **Schaum's outline of electric circuits**, McGraw-Hill, 2002.

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Average student workload (teaching hours + individ.)	45 + 45 hrs
Remarks:	
<i>Updated on:</i>	04.04.2012