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 McMahon, **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.

e-mail of the course coordinator and academic teachers	zygmunt.piatek@interia.pl
Average student workload (teaching hours + individ.)	45 + 45 hrs
Remarks:	
Updated on:	*04.04.2012*