Electrical Engineering and Electronics 1 (EEE1)

Student Group

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You already know V-I-R and you not only connect AC/DC with music?
Great! Then you should Go one step further.

This course introduces the fundamental principles of electrical engineering and electronics.
It spans from basic electrical quantities to DC networks, electrostatics, magnetostatics, and a first introduction to operational amplifiers.
The course combines theory, worked examples, and practical exercises with simulations and real-world devices.

Block plan

Introduction in Electrical Engineering 1

Chapter 1 — Electrical Fundamentals or: Watt is Power and Current?

- Block 01 — Physical Quantities and Units
- Block 02 — Electric Charge, Current and Voltage
- Block 03 — Resistance and Power

Chapter 2 — DC Networks or: something lumpy with two Pins and why shortcircuits may be important

- Block 04 —

Chapter 3 — Electric Fields or: positivity might be repulsive

- Block 09 — Force on Charges and electric Field Strength
- Block 10 — Field Patterns of key Geometries
- Block 11 — Influence and Displacement Field
- Block 12 — Capacitors and Capacitance
- Block 13 — Capacitor Circuits and Energy
- Block 14 — Steady Conduction Field

Chapter 4 —

Chapter 5 — Operational Amplifiers - golden rules and infinite gain

- Block 21 — Op-Amp Basics
- Block 22 — Negative-feedback Op-Amp Circuits
- Block 23 — Comparator Circuits
- Block 24 — Wrap-up and Applications

Kirchhoff's Laws
- Block 05 — Resistive Networks
- Block 06 — Real Sources and Source Equivalents
- Block 07 — Power-relevant Figures
- Block 08 — Two-terminal Theory and Transforms

Magnetic Fields or: Why ist the north pole on the south pole?

- Block 15 — Magnets, their Effects and Fieldline Images
- Block 16 — Ampère's law and MMF
- Block 17 — Magnetic Flux Density and Forces
- Block 18 — Magnetic Flux and Induction
- Block 19 — Magnetic Circuits
- Block 20 — Inductivity and Energy

Preparation for the Exam

Learning outcomes

After completing this course, students will be able to:

1. Apply SI units, prefixes, and electrical terminology consistently.
2. Explain and calculate fundamental electrical quantities such as charge, current, voltage, resistance, power, and energy.
3. Analyze DC circuits using Kirchhoff's laws, source equivalents, and two-port theory.
4. Describe electric and magnetic fields, calculate key field distributions, and apply them to capacitors, inductors, and energy storage.
5. Design and analyze simple operational amplifier circuits with feedback and comparator functions.

Prerequisites

1. Basic physics (mechanics, Newton's laws, Coulomb's law).

2. Basic calculus (differentiation and integration).
3. Familiarity with algebraic manipulation.

Grading and assessment

Assessment is done only by the final written exam.

Additional Links

English

- Electrical Engineering - Fundamentals: A great, compact textbook covering about the same range as this course.
  (Use University VPN to get the textbook)
- Circuit Analysis and Design is a beautifully written and illustrated textbook with the same range of topics like this course.
  (It is also free to download - after filling in your data - and used in many US universities.)
- A great introductary script into electrical engineering can be found at LibreText - Physics II Thermodynamics, Electricity and Magnetism. The content ist originally from OpenStax and covers most of the parts of my course
- Another good introduction ist given by HyperPhysics
- Alternatively, Tony R. Kuphaldt developed a very detailed and easy booklet on EEE1 and EEE2: online version
  PDF for EEE1,PDF for EEE2, PDF for semiconductor part

German

- Online Brückenkurs des KIT/Uni Stuttgart: Nice, partly animated online script
- H.Er.T.Z der HS Karlsruhe: The **H**ochschuloffene **E**lekt**r**o**t**echnik **Z**entrum of the Karlsruhe HS has a nice online script
- LeifiPhysik: Here you can find further explanations of our chapters on vocational school/gymnasium level.

- simple club: explanatory videos on electrical engineering in the field of physics ; subscription not necessary!
- Elektrotechnik einfach erklärt: still few, but well developed videos
- Elektrotechnik in 5 Minuten: good fund of short videos

Excercises

- In addition to the H.Er.T.Z script (see above), there are further exercises.
- Further exercises will be distributed via ILIAS