# Objectives Electrostatics

| Topic | Objectives |
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| Electric charges (18.1, 18.2, Basic Phenomena) | Know examples of positive and negative charge<br>Know different methods how to detect charges<br>Describe how magnitude and sign of a charge can be measured (electroscope, neon bulb)<br>Know the magnitude of the elementary charge<br>Explain what a charge carrier is<br>Explain the "creation" of charges using the concept of charge separation and conservation (e.g. Van-de-Graaff generator) |
| Conductors and Insulators (18.3, 18.8) | Describe charge distribution in conductors and insulators<br>Explain what a Faraday cage is (electric shielding)<br>Know typical examples of conductors and insulators |
| Induction (18.4) | Explain the term "electric induction"<br>Explain induction with permanent or spontaneous dipoles |
| Coulomb's Law (18.5) | Calculate forces between point charges (magnitude and direction)<br>Realise analogies with gravitational force |
| Electric field (18.6, 18.7) | Explain term "electric field"<br>Distinguish charges producing a field and test charges in a field<br>Sketch field lines for a given arrangement of charges<br>Explain what a homogeneous field is and how it can be realised<br>Basic calculations with electric field<br>Describe a method to determine the elementary charge<br>Calculations with homogeneous field or field of point charges<br>Determine superposition of electric fields (graphically and/or algebraically) |
| Gauss' Law (18.9) | Explain term „electric flux" in words and/or with a sketch<br>Calculate flux through a surface for simple situation<br>Determine magnitude of electric field for a simple, symmetric charge distribution using Gauss' law (e.g. straight wire)<br>Calculate magnitude of electric field on the surface of conductor from charge density (e.g. charged plate) |
| Potential and potential difference (19.1, 19.2, 19.3, 19.4) | Calculate work in a homogeneous field<br>Explain the terms "electric potential energy", "electric potential", "potential difference" and "voltage"<br>Calculate potential difference between two points in a homogeneous electric field or in the field of point charges<br>Describe the trajectory of a charged particle in a homogeneous field<br>Describe Cathode Ray Tube (CRT) and Cathode Ray Oscilloscope (CRO)<br>Match deflection voltages and CRO graph<br>Calculations with conservation of energy in an electric field<br>Calculate velocity from acceleration voltage<br>Use energy unit eV<br>Sketch equipotential surfaces for a given charge distribution |

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| Capacitor (19.5) | Calculate capacity of a capacitor from applied voltage and stored charge<br>Calculate capacity of a parallel plate capacitor from geometry (also for capacitors partially filled with insulator)<br>Describe two different types of capacitors<br>Know typical values for capacity<br>Describe two applications of capacitors<br>Know relation between permittivity of free space and Coulomb's constant<br>Explain dielectric constant with polarisation in dielectrics<br>Calculate energy stored in a capacitor (any combination of capacity, charge and voltage)<br>Calculate energy density from magnitude of electric field |

| **Constant** | **Value** |
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| Elementary charge | $e = 1.6 \cdot 10^{-19}$ C |
| Electron mass | $m_e = 9.1 \cdot 10^{-31}$ kg = 511 keV/c² |
| Nucleon mass | $m_p \cong m_n = 1.67 \cdot 10^{-27}$ kg = 939 MeV/c² |
| Coulomb's constant | $k = 9 \cdot 10^9$ N·m²/C² |
| Permittivity of free space | $\varepsilon_o = \frac{1}{4\pi \cdot k} = 8.854 \cdot 10^{-12} \frac{\text{As}}{\text{Vm}}$ |

| **Property** | **Table** |
|---|---|
| Properties of electrons and nucleons | FoTa T 165 |
| Dielectric constant | FoTa T 177 |