Fundamentals of Electrical Engineering: Static and Stationary Fields (SSF)

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Tutors

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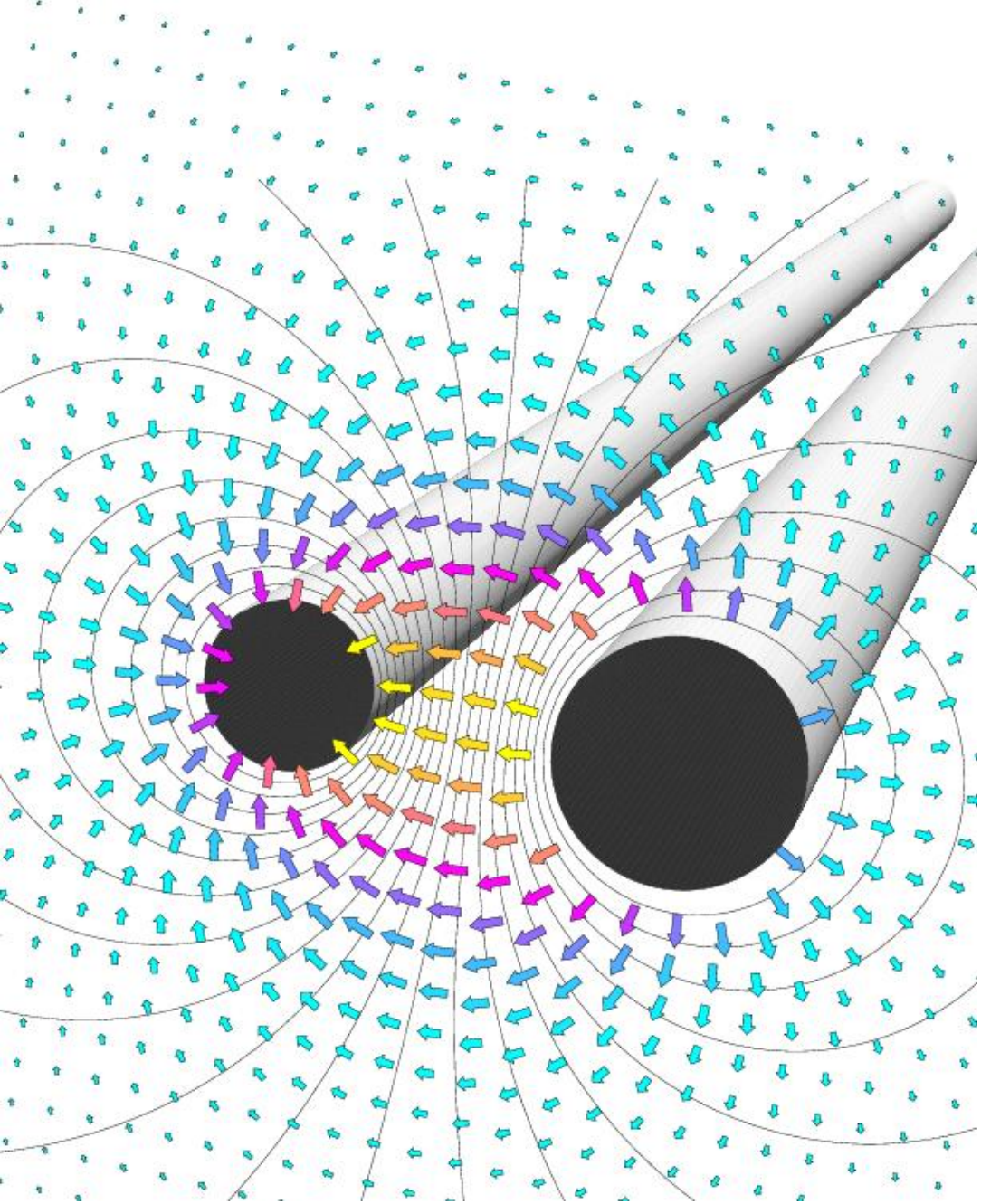


Content of SSF

0. Introduction
1. Electric Field
2. Electric Current
3. Magnetic Field

General Information

Ingo Wolff
Verlagsbuchhandlung
Dr. Wolff, 2003
401 pages, € ~ 35.50

- This course based on the German course "Grundlagen der Elektrotechnik I"

- **Textbook:**
  "Grundlagen der Elektrotechnik 1"
  unfortunately, only German version available

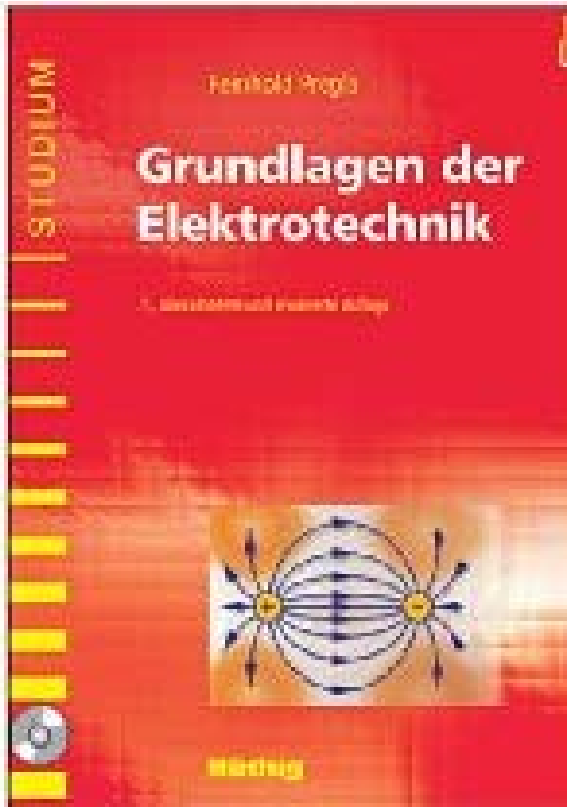
- **Supporting Documents:**
  Use Moodle-Server:
  http://moodle.uni-duisburg-essen.de/

  Fakultät für Ingenieurwissenschaften
  Abteilung Elektro- und Informationstechnik
  Look for "Nanostrukturtechnik"

  Login password: not required

→ All transparencies of the course
→ Exercises

General Information

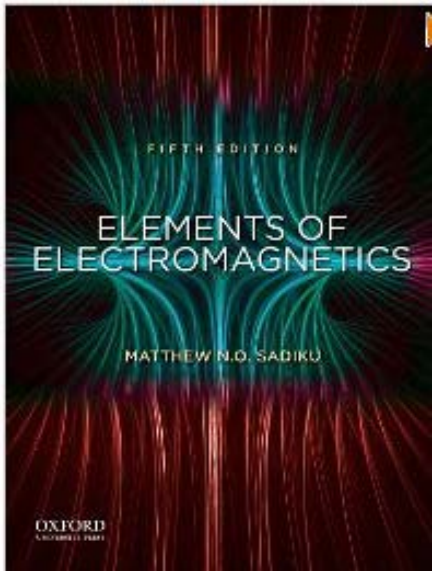


"Grundlagen der Elektrotechnik"
Reinhold Pregla
Hüthig Verlag
2009
535 pages, € ~ 50 €

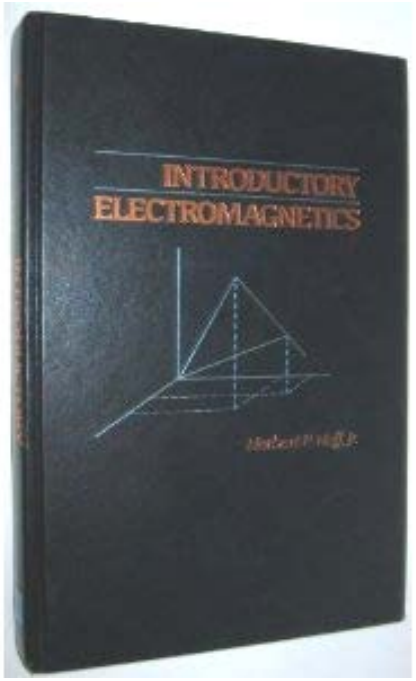
- only German version available
- contains SSF and NA

General Information

- **English Books:**



Matthew N.O. Sadiku:
Elements of Electromagnetics,
Oxford University Press 2010
ISBN 978-0-538775-9
(For beginners, Math-Intro
Contains more than SSF!)

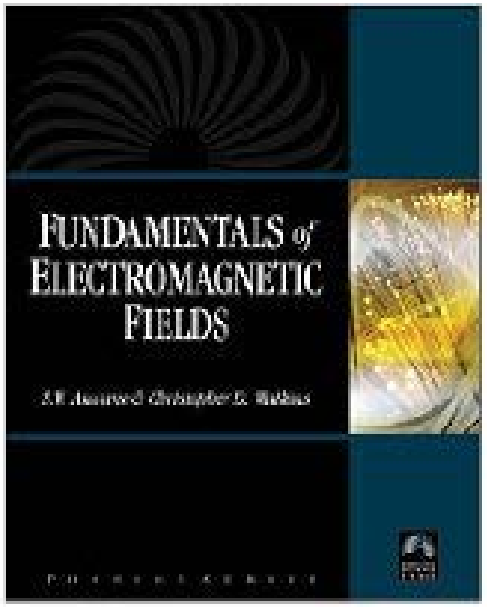


Herbert P. Neff:
Introductory Electromagnetics, John Wiley & Sons Inc.
ISBN-10: 0471605506;
(For beginners, Math-Intro
Contains more than SSF!)

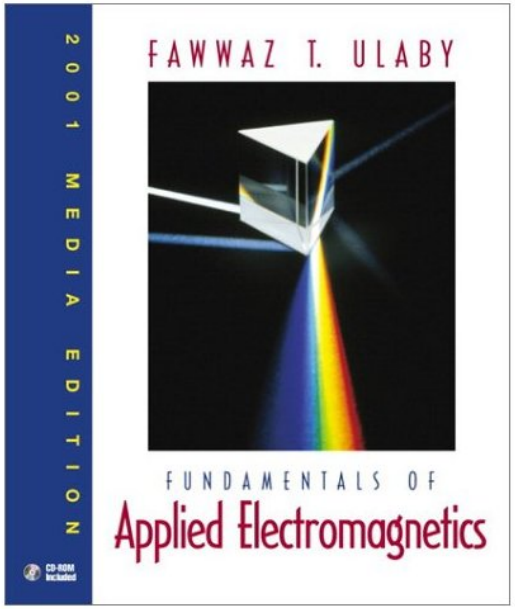
There are also several internet sources, like the web pages of the MIT:
http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/coursenotes/index.htm

General Information

- **English Books:**



S. W. Anwane:
Fundamentals of Electromagnetic Fields
(ISBN-10: 1934015008)
(Contains more than SSF!)

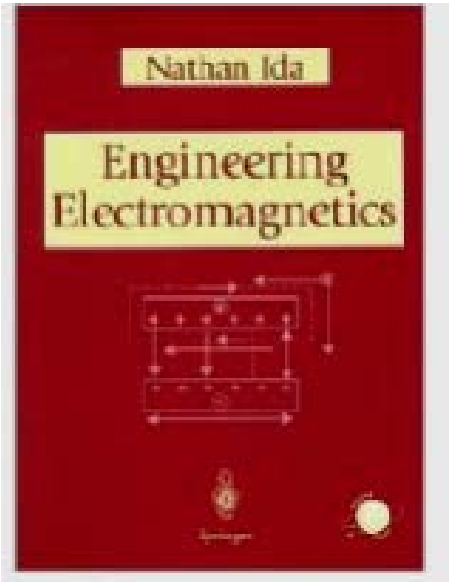


Fawwaz Ulaby:
Fundamentals of Applied Electromagnetics, Prentice-Hall 2001
ISBN-10: 0130329312
(For beginners,
Contains more than SSF!)

There are also several internet sources, like the web pages of the MIT:
http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/coursenotes/index.htm

General Information

- **English Books:**



Nathan Ida,
Engineering Electromagnetics
Springer, 2000, 1231 pages,
(Contains much more than SSF!)

There are also several internet sources, like the web pages of the MIT:
http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/coursenotes/index.htm

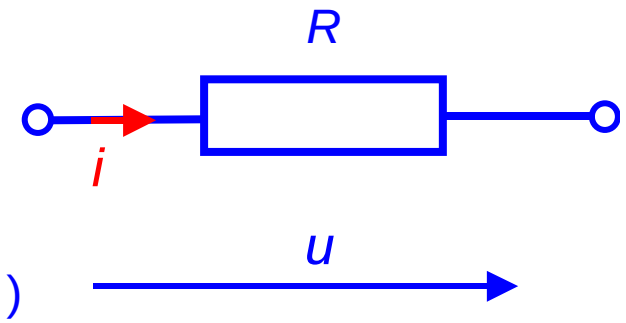
0. Introduction

- Motivation
- The Term „Field”

Motivation

In Network Analysis (NA)

The element resistance



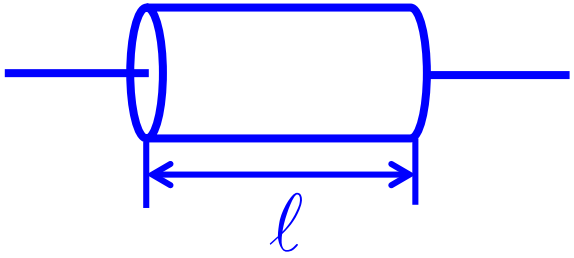
)

$$u = R \cdot i$$

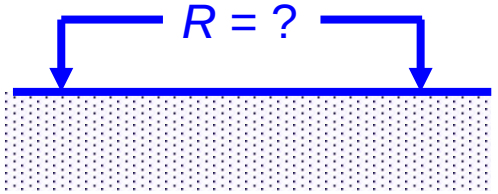
$$[R] = \left[\frac{u}{i}\right] = \frac{V}{A} = \Omega$$

Now here in SSF

How is the resistance related to the geometry and material?



Ground resistance:

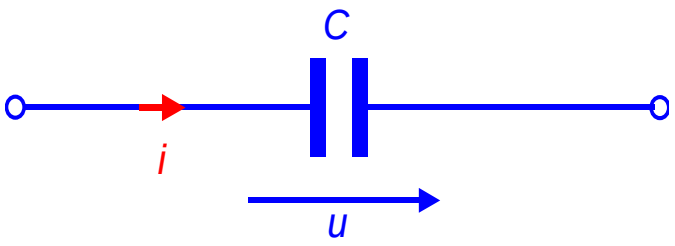


What is the general formula for the resistance ?

Motivation

In Network Analysis (NA)

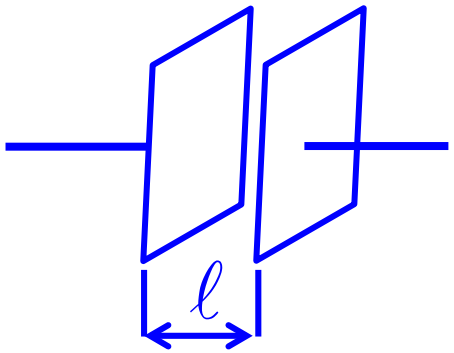
The element capacitance



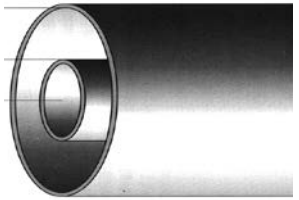
$$i = C \cdot \frac{du}{dt}$$

Now here in SSF

How is the capacitance related to the geometry and material?



Cylinder capacitor

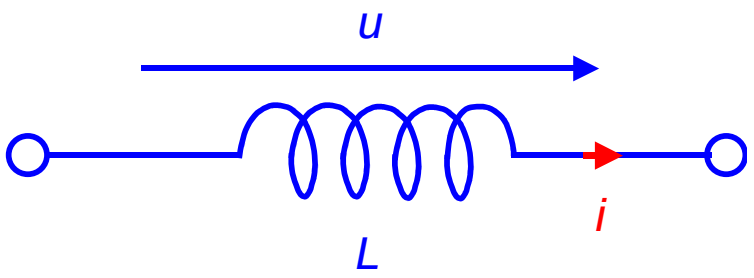


What is the general formula for the capacitance?

Motivation

In Network Analysis (NA)

The element inductance

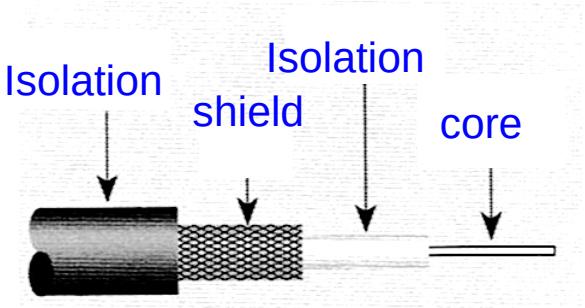


$$u = L \cdot \frac{di}{dt}$$

Now here in SSF

How is the inductance related to the geometry and material?

What is the inductance of a coaxial cable?

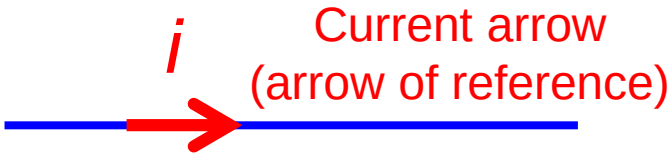


How can the inductance be calculated in general?

Motivation

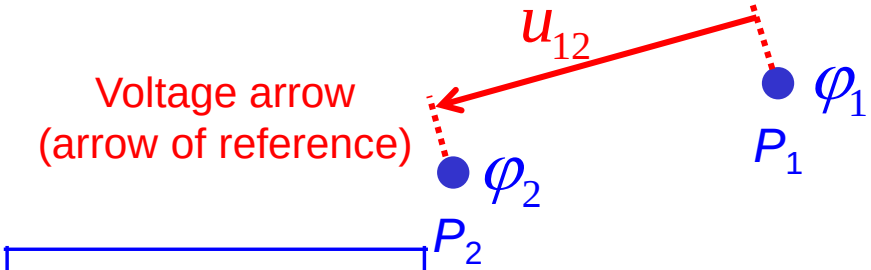
In Network Analysis (NA)

The electric current strength



$$i = \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}$$

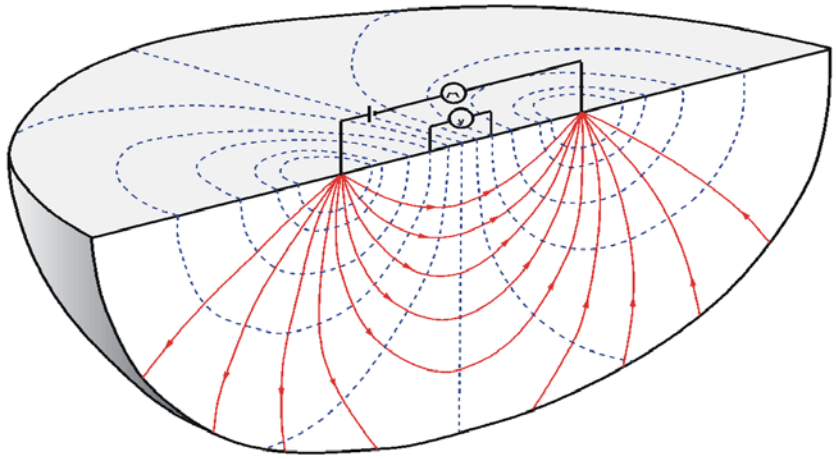
The electric voltage



$$u_{12} = \varphi_1 - \varphi_2$$

Now here in SSF

How are current and voltage distributed within a material?



What are fundamental laws?

The Term "Field"

Terminology:
Each physical quantity, which is a function of the position $\vec{r}$ in space, where $\vec{r}$ describes the position vector, is called a field.

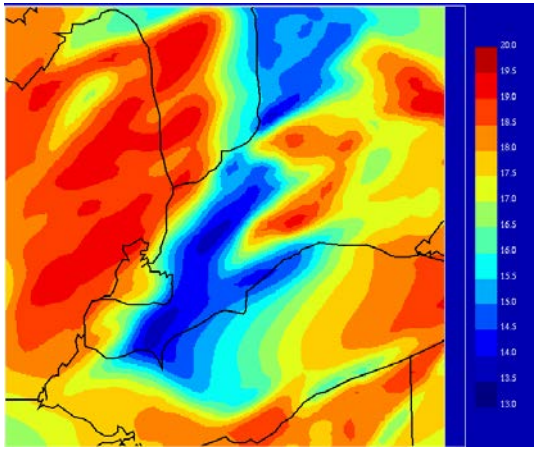
If the quantity is a scalar
(has no direction, like temperature)
the quantity forms a scalar field.

If the physical quantity is a vector
(has a specific direction, like a force),
it forms a vector field.

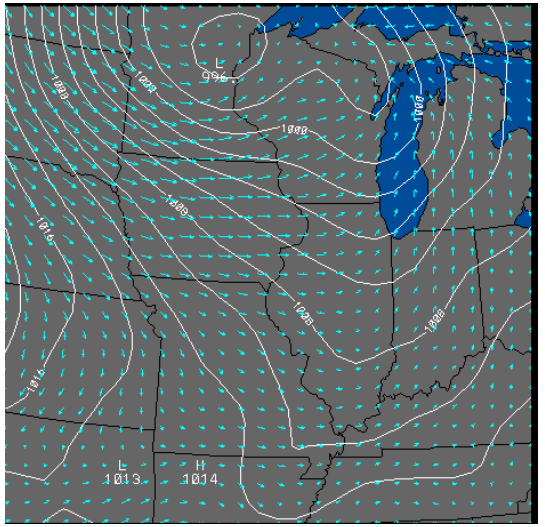
Static field: nothing moves, there is no time-dependency (electrostatic and magnetostatic fields)

Stationary field: something moves, but the distribution of this movement (its field) is time-independent. (stationary electric current)

Example



Temperature field



Wind field