

CHAPTER OVERVIEW

6: Electromagnetism

This chapter discusses two major effects that arise when electric and magnetic fields are changing in time: the “electromagnetic induction” of an additional electric field by changing magnetic field, and the reciprocal effect of the “displacement currents”- actually, the induction of an additional magnetic field by changing electric field. These two phenomena, which make time-dependent electric and magnetic fields inseparable (hence the term “electromagnetism”¹), are reflected in the full system of Maxwell equations, valid for an arbitrary electromagnetic process. On the way toward this system, I will make a pause for a brief review of the electrodynamics of superconductivity, which (besides its own significance), provides a perfect platform for a discussion of the general issue of gauge invariance.

[6.1: Electromagnetic Induction](#)

[6.2: Magnetic Energy Revisited](#)

[6.3: Quasistatic Approximation, and the Skin Effect](#)

[6.4: Electrodynamics of Superconductivity, and the Gauge Invariance](#)

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[6.6: Inductors, Transformers, and AC Kirchhoff Laws](#)

[6.7: Displacement Currents](#)

[6.8: Finally, the Full Maxwell Equation System](#)

[6.9: Exercise Problems](#)

Reference

¹ It was coined by H. Ørsted in 1820 in the context of his experiments – see the previous chapter.

Thumbnail: The magnetic field of a current-bearing coil, illustrating field lines. (CC BY 4.0; Y. Qing).

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