Course Syllabus PHYS 204

General Physics III-FALL 2020 (Term 201)

1. **Instructor Details:** Dr. Watheq Al-Basheer, PhD
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   Tel: 013-860-2216 Fax: 013-860-2293

2. **Times and Locations:** Lecture - UTR 09- :50, location 6-201 (Online)
   Lab. - W 12:15 - 2:55, Location (Virtual lab)

3. **Course Description & Objective:**

Inductance; magnetic properties of matter, electromagnetic oscillations and waves; geometrical and physical optics. Relativity, introduction to quantum physics, atomic physics, solids, nuclear physics, particle physics and cosmology. Prerequisites: PHYS 102, MATH 102

The Lab component of General Physics III consists of selected experiments in electrical circuits, geometrical and physical optics as well as modern physics.
Co-requisite: PHYS 204

4. **Textbook:** "Fundamentals of Physics", by Halliday, Resnick and Walker, Eleventh Edition, John Wiley & Sons, Inc. (2018).

5. **Attendance policy: DN** grade will be given to student absences exceeding 12 lectures or 3 Labs or a combination.

8. **Academic Integrity:** Students are expected to be honest and to submit their own homework assignments and exams.

9. **Grading Policy:**

		Percentage
Class-work (quizzes)		30%
HW Assignments		30%
Mid Term Exam (*CH30 – CH37, date and time TBA*)		15%
Final exam	(*All covered topics, date and time TBA by Registrar*)	25%

PHYS 204 Chapters & Topics

CH.#	Chapter: Topics
30	**Induction and Inductance**: Faradays Law of Induction, Inductance, RL Circuits, Mutual Inductance.
31	**Electromagnetic Oscillations and Alternating Current**: LC Oscillations, RLC Circuits, Series RLC Circuits.
32	**Maxwell's Equations: Magnetism of Matter**: Gauss' Law for magnetic field, Maxwell's equations, Magnetic Materials.
33	**Electromagnetic Waves**: EM Waves (Qualitative and Quantitative Analysis), Energy Transport, Total Internal Refraction.
34	**Images**: Plane and spherical Mirrors, Spherical Refracting Surfaces and thin lenses.
35	**Interference**: Light as a wave and diffraction, Young's Interference experiment, Intensity in Double Slit Interference.
36	**Diffraction**: Diffraction & Wave Theory of Light, Diffraction by Double Slit, Diffraction Gratings.
37	**Relativity**: The postulates, Measuring and event, Relativity of Time and Length, Lorentz Transformation, Doppler Effect for Light
38	**Photons and Matter Waves**: Photon, The Quantum of Light, Photons Have Momentum Schrodinger's Equation.
39	**More About Matter Waves**: Energy of Trapped Electron, Two and Three Dimensional Trap, The Hydrogen Atom.
40	**All About Atoms**: Properties of Atoms, Pauli Exclusion Principle, Lasers
41	**Conduction of Electricity in Solids**: Electronic Properties, Metals, Semiconductors
42	**Nuclear Physics**: Some Nuclear Properties, Radioactive Decay, β Decay
43	**Energy from the Nucleus**: Energy from the Nucleus

PHYS 205 Grading Policy

	Percentage
Pre-lab quizzes	25%
Lab work (Reports)	60%
Presentation	15%

PHYS 205 Virtual lab Schedule

Experiment	Date
Data and Error Analysis	09/09/2020
RC Circuit	09/16/2020
RLC Circuits	09/30/2020
Polarization of Light	10/07/2020
Thin Lens and Spherical Mirrors	10/14/2020
Refractive Index and Colors	10/21/2020
Michelson Interferometer	11/11/2020
Diffraction of Light	11/18/2020
Atomic Constants	11/25/2020
Radiation detection	12/02/2020

TIPS FOR GOOD LAB REPORT WRITING

This course will provide you with multiple opportunities to develop and foster your skills of conducting and reporting science.

1- Your lab report should be brief and to the point. You must say everything you need to say. You can either type your report or hand write it.
2- Fundamentally, there are five main sections to a scientific lab report: Experiment title and your name, Abstract (objectives), Results and discussions, answering all questions and then ending with conclusions.
3- Any symbol or expression used in your report must be defined. This includes any symbols or expressions in figures, diagrams and equations. Also figure captioning should be present for every figure.
4- Units should be consistent. Figures Axes should be well-defined with proper units.
5- If your experiment involves determining a physical constant, then you should include in your report calculation of the percentage error showing the deviation of your experimentally found value from the real and well-known one.
6- Whether your results and calculations agree very well with theory or not, you should comment on your results, giving scientific reasons and explanations on the agreement or the disagreement.

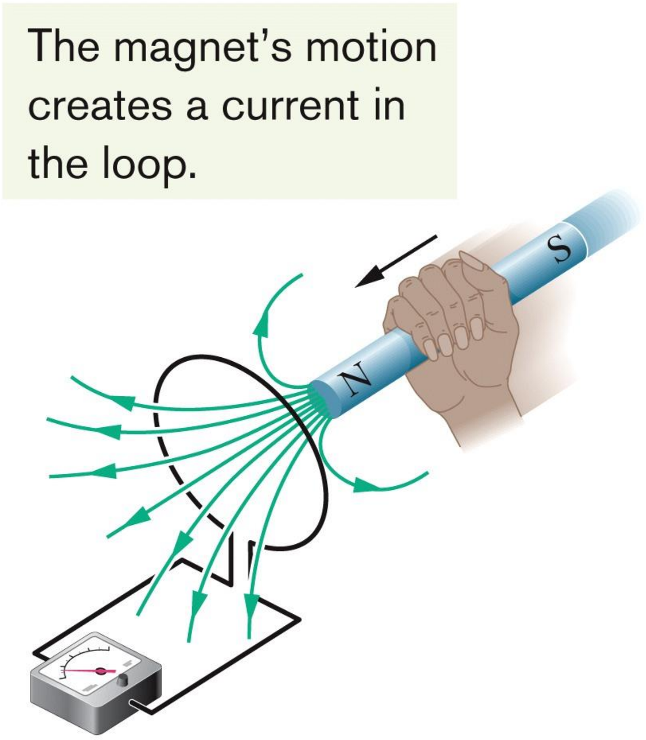
Induction and Inductance

Chapter 30

Lecture 1

30-1 Faraday's Law and Lenz's Law

First Experiment. Figure shows a conducting loop connected to a sensitive ammeter. Because there is no battery or other source of emf included, there is no current in the circuit. However, if we move a bar magnet toward the loop, a current suddenly appears in the circuit. The current disappears when the magnet stops moving. If we then move the magnet away, a current again suddenly appears, but now in the opposite direction. If we experimented for a while, we would discover the following:

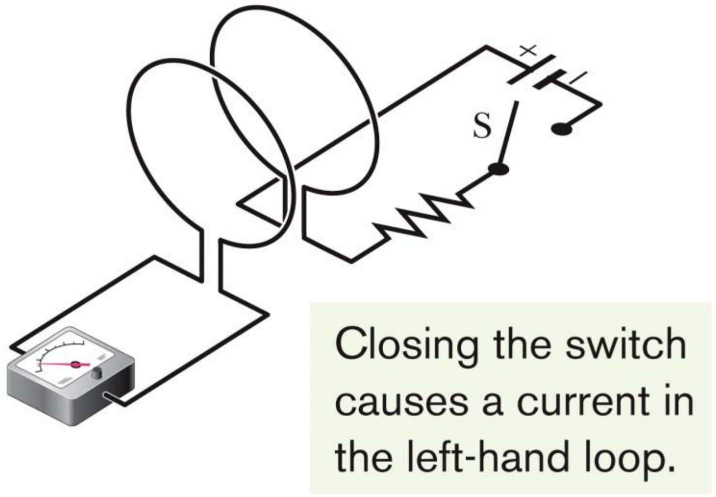


30-1 Faraday's Law and Lenz's Law

1. A current appears only if there is relative motion between the loop and the magnet (one must move relative to the other); the current disappears when the relative motion between them ceases.
2. Faster motion of the magnet produces a greater current.
3. If moving the magnet's north pole toward the loop causes, say, clockwise current, then moving the north pole away causes counterclockwise current. Moving the south pole toward or away from the loop also causes currents, but in the reversed directions from the north pole effects.

30-1 Faraday's Law and Lenz's Law

Second Experiment. For this experiment we use the apparatus shown in the figure, with the two conducting loops close to each other but not touching. If we close switch S to turn on a current in the right-hand loop, the meter suddenly and briefly registers a current—an induced current—in the left-hand loop. If the switch remains closed, no further current is observed. If we then open the switch, another sudden and brief induced current appears in the left-hand loop, but in the opposite direction.



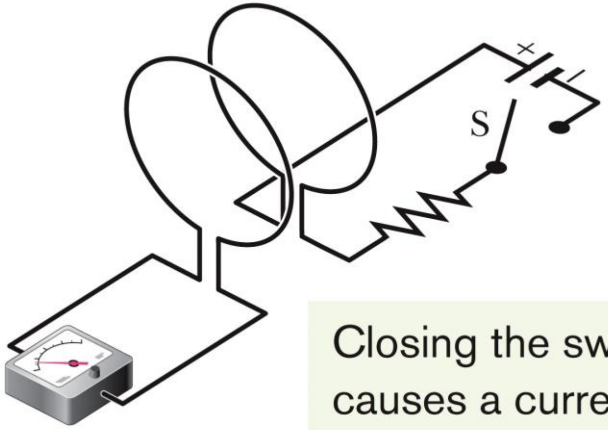
30-1 Faraday's Law and Lenz's Law

We get an induced current (from an induced emf) only when the current in the right-hand loop is changing (either turning on or turning off) and not when it is constant (even if it is large). The induced emf and induced current in these experiments are apparently caused when something changes — but what is that "something"? Faraday knew.

30-1 Faraday’s Law and Lenz’s Law

Faraday’s Law of Induction

Faraday realized that an emf and a current can be induced in a loop, as in our two experiments, by changing the amount of magnetic field passing through the loop. He further realized that the “amount of magnetic field” can be visualized in terms of the magnetic field lines passing through the loop.



Closing the switch causes a current in the left-hand loop.

30-1 Faraday's Law and Lenz's Law

The magnetic flux Φ_B through an area A in a magnetic field $\vec{B}$ is defined as

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

where the integral is taken over the area. The SI unit of magnetic flux is the weber, where $1\ \mathrm{Wb} = 1\ \mathrm{T} \cdot \mathrm{m}^2$.

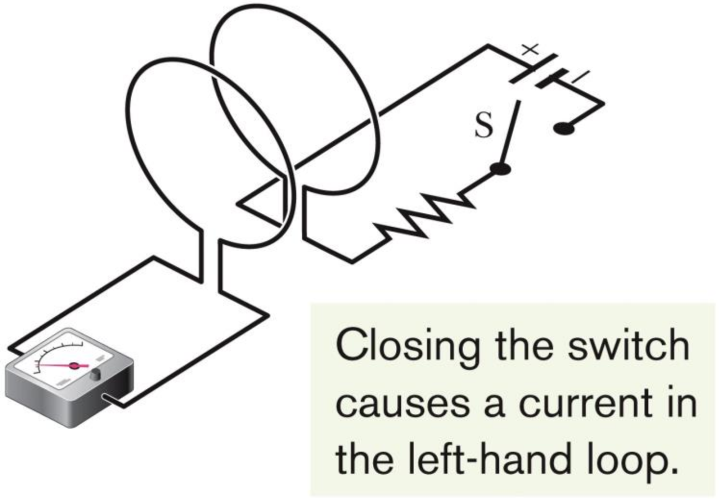
If B is perpendicular to the area and uniform over it, the flux is

$$\Phi_B = BA \qquad \left(\vec{B} \perp \text{area } A, \vec{B} \text{ uniform}\right).$$

30-1 Faraday's Law and Lenz's Law

Faraday's Law of Induction

The magnitude of the emf $\mathcal{E}$ induced in a conducting loop is equal to the rate at which the magnetic flux Φ_B through that loop changes with time.



30-1 Faraday's Law and Lenz's Law

Faraday's Law. With the notion of magnetic flux, we can state Faraday's law in a more quantitative and useful way:

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

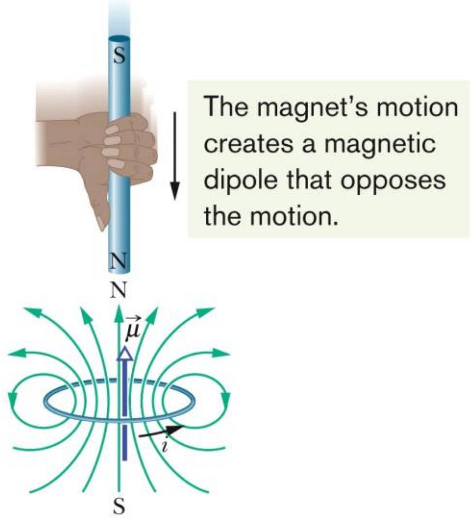
the induced emf tends to oppose the flux change and the minus sign indicates this opposition. This minus sign is referred to as Lenz's Law.

30-1 Faraday's Law and Lenz's Law

Lenz's Law

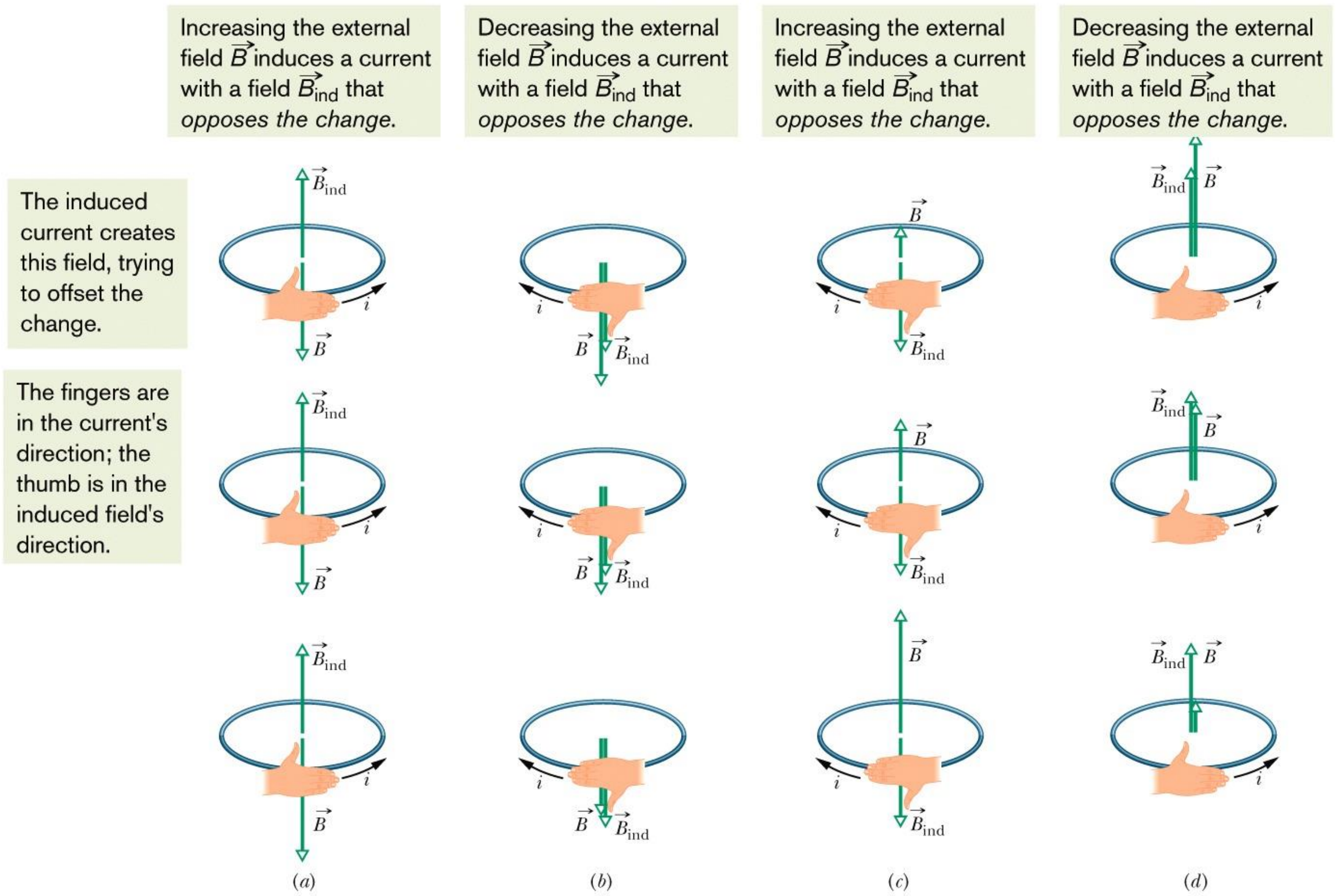
An induced current has a direction such that the magnetic field due to this induced current opposes the change in the magnetic flux that induces the current. The induced emf has the same direction as the induced current.

Lenz's law at work. As the magnet is moved toward the loop, a current is induced in the loop. The current produces its own magnetic field, with magnetic dipole moment $\vec{\mu}$ oriented so as to oppose the motion of the magnet. Thus, the induced current must be counterclockwise as shown.



30-1 Faraday's Law and Lenz's Law

Lenz's Law



30-1 Faraday's Law and Lenz's Law

The direction of the current i induced in a loop is such that the current's magnetic field $\vec{B}_{\text{ind}}$ opposes the change in the magnetic field $\vec{B}$ inducing i. The field B_{ind} is always directed opposite an increasing field $\vec{B}(a, c)$ and in the same direction as a decreasing field $\vec{B}(b, d)$. The curled – straight right-hand rule gives the direction of the induced current based on the direction of the induced field.