Lecture 32 iq28

1. Motional emf is one special case of Faraday’s law.

2. Discussions on selected problems in Ch23.h1.
   - 001-006
   - 007 Ec can be directed directly from Faraday’s law independent of the presence of the wire loop.
   - 8-9 Total energy dissipated. P=IV, V=IR.
   - 10 Figures involve coils.
   - 12 Calculation of the flux in a loop where B depends on x.
   - A problem which calculates E_{NC}

Announcement:

Re: Adjustment on present lesson plan

Our lectures are slightly behind our original lesson plan. The updated lesson plan is as follows.

- Postpone the due date of ch23.h2 from the coming Sunday to next Tuesday.
- Due dates of ch23.h3 and ch24.h1 will be on the Wednesday of the following week. (Using present lesson plan notation, it is “W”)
- Ch24.h2, ch24.h3 on Su.
- Ch24 h4, ch24.h5 on W
- Ch25-h1 on Su

Midterm3 will now cover the exam materials only through ch23-h2. Notice that the inductance and the LR circuit are covered in ch23-h2. They will be included in the exam. On the other hand problems which involve LC circuits only appear in ch23-h3. They will not be included in this exam.
Motional emf is a special case of Faraday's Law.

General form of Faraday's law:

\[ E = \int_{\text{path}} E \cdot dl = -\frac{d\Phi}{dt} \quad \text{path} \]

The path is the
Faradian loop here.

\[ \text{RHS} = -\frac{dB}{dt} \cdot A = B\frac{dA}{dt} \quad (1) \]

Check: Moving rod along two rails setup gives

\[ \text{emf} = vBL \] which can be derived based on

Faraday's Law.

From motional emf:

\[ E = \frac{\delta v}{\delta t} = vBL \quad (2) \]

Lorentz force: higher potential

\[ E = \text{CW} \quad (2') \]

From RHS of eqn., i.e., eq(1):

\[ -\frac{BdA}{dt} = \frac{Bdx}{dt} = \frac{Bdx}{dt} \]

Lorentz law implies Bin in $\Theta$, a E in CW, (3)

We see $(2) + (2')$ agree with $(3) + (3')$. The motional emf
is a special case of Faraday's Law.

One can show in the case of current loop from both
consideration one finds

\[ E = \text{Emax} \sin \omega t \]

where for $N$ turn coils,

\[ \text{Emax} = NvBL \]
2) What is \( E_{in} \) at \( P \) when \( I = \text{const} \)?
- \( E_{in} \) is 0, or \( \Delta E > 0 \).

3) At \( t_2 \) as \( I \downarrow \), find \( \langle E_{in} \rangle \). Every pattern is greater.
- Where: \( \langle E_{in} \rangle = \frac{I}{2} \Delta I \)

4) Find \( \frac{\Delta L}{\Delta t} \).
- \( \frac{\Delta L}{\Delta t} = \left| \frac{\Delta I}{\Delta t} \right| = \frac{L}{\Delta t} \Delta I \)

5) \( I_{\text{emf in loop}} = \frac{\Delta Q}{\Delta t} \).

6) \( 2\pi I_{\text{End}} = \frac{1}{2\pi I_{\text{End}}} \), \( I_{\text{End}} = \frac{1}{2\pi I_{\text{End}}} \).

7) \( I_{\text{End}} \) to \( \text{Wordloop} \)
- Remember.
Remove the ring for \( B=0 \) region

for the region where \( B=0 \) in \( \tau_1 \), Assume ring resistance \( R \).

Find: \( \text{ave } E \), Energy consumed

\[
\text{ave } E = \frac{(B_A - 0)}{\ell} = \frac{B A}{\ell} \text{ volts,}
\]

Energy consumed = \( P \Delta t = I E \Delta t = \frac{E^2}{R} \Delta t \),

\( |\mathbf{E}| = |\mathbf{E}t| \)  Assume same e.m.f. but \( t \)-related

\( \mathbf{E} \) = \( \mathbf{E}_t \)  Shrink down to \( 0 \),

\[ \text{Energy} = P \Delta t = \frac{E^2}{R} \Delta t, \]

\[ \mathbf{B}_2 \]: Determine \( \langle \mathbf{B} \rangle \) at right coil due to motion of \#1

\[ \langle \mathbf{B} \rangle \leftrightarrow ? \]

\#1

Suppose \#2

\[ \mathbf{B}_\text{in} \rightarrow \mathbf{P}_1, \mathbf{P}_2 \]
If \( I \) is decreasing, find direction of current in the loop.

Choose: Other ccw.

Find \( \text{loop} \). Hint: \( \text{loop} = \int \frac{\text{d}I}{\text{d}t} \)

\[
\oint \text{d}y B = \int \frac{\text{d}I}{\text{d}t} \int h \, \text{d}x \frac{h_{\text{L}} I}{\text{d}t}
\]

\[
= \frac{h_{\text{L}} dI}{\text{d}t} \int h \int \frac{\text{d}x}{\text{d}t}
\]

Determine the direction of the force on the segment AB as B is decreasing.

Hint: The force on PP' is given by

\[
F_{\text{Bin}} = I_{\text{in}} h \times B_{\text{in}} .
\]

First determine the direction of \( B_{\text{in}} \)

(should it be into or out).

The correct response is to keep flux within the loop constant.

Hint: To find Eq. at P

First write down Faraday's Law:

For the Faraday loop:circula. loops thru P, centred at