Generation and Transmission of electricity Cheat Sheet

by cadmiumium via cheatography.com/135751/cs/28194/

magnetic flux

$\Phi = B \perp A$

·B=magnetic field strength (T)
·A=area perpendicular to the magnetic field (m^2)
·Φ=magnetic flux (Wb)

Faraday's Law

$\varepsilon = -N(\Delta\Phi/\Delta t)$

ε=EMF(V), N=number of turns in coil

·($\Delta\Phi/\Delta t$) is the derivative of Φ with respect to time.
·ε graph should be negative when Φ-t graph has +ve gradient
·ε graph should be positive when Φ-t graph has -ve gradient

Lenz's Law

An induced current will flow in a direction such that the magnetic field created by the current will oppose the change in flux that induced the current.

Right Hand coil rule:
·thumb: direction of induced magnetic field
·fingers: direction of induced current

how to find induced current

Problem solving process

To determine the direction of an induced current:

1 Identify whether the magnetic flux is **increasing or decreasing**.
2 Identify the **direction of the original magnetic field** ('up', 'right', 'into the page' etc.).
3 Identify the **direction of the induced magnetic field**:
   - If the flux is **increasing** (found in step 1) then the magnetic field is in the **opposite direction** to the original field (found in step 2).
   - If the flux is **decreasing** (found in step 1) then the magnetic field is in the **same direction** as the original field (found in step 2).
4 Apply the right-hand coil rule, with thumb pointing in the direction of the induced magnetic field identified in step 3, to determine the **direction of the induced current**.

generators and alternators

$f=1/T$

f=frequency (Hz), T=period of revolution(s) - time taken to complete a full cycle

*max ε when coil is parallel to magnetic field, ie. greatest rate of change

*DC current can only be produced in presence of a split ring commutator

Alternator (AC): sinusoidal

DC generator: modulus of AC

·$\Phi(t)=a\cos(2\pi ft)$
·$\varepsilon=\Phi'(t)=-2a\pi f\sin(2\pi ft)$

electricity recap

$V=I \cdot R$ - V(V), I(A), R(Ω)

$P_{supply}=V \cdot I$ - also: power rating

$P_{dissipated}=I^2 \cdot R=V^2/R$

Power (W) is the rate of change of energy with respect to time

$P=\Delta E/\Delta t$ - gradient of E-t graph

series circuit:
·current (I) is the same through the whole circuit
·flow: from positive to negative terminal
·total resistance (RT) is the sum of individual resistances: $R_1+R_2+\ldots$
·total voltage supplied to a circuit must be equal to the total voltage used around the circuit (sum of voltage drops): $V_{supply}=V_1+V_2+\ldots$

Transformers, comparing AC and DC

$V_{RMS}=V_{peak}/\sqrt{2}$, $I_{RMS}=I_{peak}/\sqrt{2}$

$P_{avg}= V_{RMS} \cdot I_{RMS} = I_{RMS}^2 \cdot R = V_{RMS}^2/R$ - avg power delivered by sinusoidal signal

Transformers:

$P_{in}=P_{out}$

$VI_{primary}=VI_{secondary}$

$V_1/V_2=N_1/N_2$

$I_1/I_2=N_2/N_1$

when $V_1>V_2$: Step-down transformer

when $V_1<V_2$: Step-up transformer

*transformers will not work for converting a DC voltage

Transmission of power (Power systems)

Power loss:

$P_{loss}=I_{line}^2 \cdot R_{line}$

Voltage drop:

$V_{drop}=I_{line} \cdot R_{line}$

$I_{load}/I_{line}=N_1/N_2$

·almost all wires have some resistance
·as electricity passes through the wires, it causes them to heat up, resulting in power loss, and a decrease in the voltage that is available at the load.

High voltage transmission

·we can reduce power loss by lowering the current in the line
·we can keep the same supply power by increasing the supply voltage
·this is done using transformers.