

Common conversions:

RMS to PEAK $\times \sqrt{2}$
 PEAK to PEAK-PEAK $\times 2$
 RMS to PEAK-PEAK $\times 2\sqrt{2}$
 PEAK to RMS $\div \sqrt{2}$
 PEAK-PEAK to RMS $\div 2$
 PEAK-PEAK to RMS $\div 2\sqrt{2}$

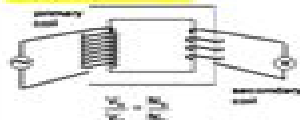
Voltage stepping:

Input power = Output power
 Current goes up $\rightarrow$ Voltage goes up
 Current and Voltage = Opposite

Voltage stepping:

$P_{in} = P_{out}$	$\rightarrow$	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$
$P_{in} = P_{out}$		

Transformers:



An alternating current within the primary coil generates an alternating current in the iron core. The alternating field passes through the secondary coil induces an EMF in the secondary coil.

Peak Max $\rightarrow$ Peak Min

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

To generate electricity, we must have a change in magnetic flux in relation to magnetic field. A transformer needs AC to create the changing magnetic field.

Step up = Primary (lower) $\rightarrow$ Secondary (higher)
 Step down = Primary (higher) $\rightarrow$ Secondary (lower)

Power loss equations:

$$P_{loss} = V_{loss} \times I_{transmission}$$

But, $V_{loss} = I_{transmission} \times R$
 $\rightarrow P_{loss} = I_{transmission}^2 \times R$

Current is inversely proportional to voltage if the power stays the same. Which is why it is best to reduce the current during transmission rather than resistance.

Magnetic flux:

The measure of the amount of magnetic field passing through an area. A constant magnetic flux does not produce an electric current, but a changing magnetic flux does.

To change a magnetic flux: move a wire through a constant field, or, rotate a loop of wire in a constant field, or, change the strength of the magnetic field.

$$\Phi_B = \mathbf{B} \cdot \mathbf{A}$$

$$\therefore B = \frac{\Phi_B}{A}$$

Φ is the magnetic flux (Wb - Weber)
 B is the magnetic field strength (T)
 A is the area (m²)

Hence, field strength can be defined as the flux density, or the number of field lines per square metre.

EMF:

EMF = Potential Difference (V) - (The electrical pressure).
 The magnitude of the induced EMF is directly proportional to the rate of change of magnetic flux.

The change in flux induces the EMF.

Induced EMF will oppose change in flux.

EMF induced:

For a single loop of wire, the induced EMF can be calculated as

$$\mathcal{E} = - \frac{\Delta \Phi_B}{\Delta t}$$

The minus sign is important, but is ignored in simple calculations

$$\Phi_B = \mathbf{B} \cdot \mathbf{A}$$

$$\begin{cases} \mathcal{E} = -A \frac{\Delta B}{\Delta t} \\ \mathcal{E} = -B \frac{\Delta A}{\Delta t} \end{cases}$$

Size of the EMF induced:

Where the magnetic field is constant, the rate of change in flux is created by the rate of change of area.

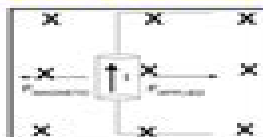
$$\mathcal{E} = -B \frac{\Delta A}{\Delta t} \text{ where } \frac{\Delta A}{\Delta t} \text{ represents the rate at which the conductor sweeps out area.}$$

EMF and more loops:

$$\mathcal{E} = -N \frac{\Delta \Phi_B}{\Delta t}$$

Lenz's law: the direction of the induced EMF is the same as the current which opposes the change in flux that created it.

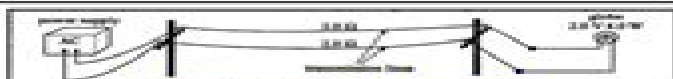
Changing the flux by moving a wire through area:



Induced current creates a magnetic field and force that will oppose the applied force. Using the right-hand rule, when:

- the current flows up, and
 - the field acts into the page
- then the force due to the magnetic field around the wire is to the **left**.

This $F_{magnetic}$ force acts to oppose the applied force - (motion)



Calculate the current in the wires:

$$I = \frac{V}{R} = \frac{4}{2} = 2A$$

Voltage output of the power supply:

$$R_{total} = 4\Omega, I_{globe} = \frac{4V}{2\Omega} = 2A, R_{globe} = \frac{2V}{2A} = 1\Omega$$

$$V = 2 \times (4 + 1) = 10V$$

Total power loss:

$$P_{loss} = I^2 R = 2^2 \times 4 = 16W$$



Current in wires:

$$P=IV, 4=2I, I=2A, R_{globe}=1\Omega, \text{ Line current} = 0.2A$$

Power loss during transmission:

$$P_{loss} = I^2 R = 0.2^2 \times 4 = 0.16W$$

Over long-distance transmission of electricity, transformers are used to step up the voltage and consequently step down the current as they are inversely proportional if power stays the same as per: $P=IV$.



Total R of transmission line = 30
 R of globe = 90, Supply = 18V DC

Power in globe A:

$$I = V/R = 2A, P = IV = 2 \times 18 = 36W$$

Voltage loss in transmission lines:

$$V=IR, I=18/12=1.5A \text{ (lines)}$$

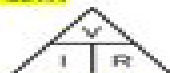
$$V=IR = 1.5 \times 3 = 4.5V$$

Power delivered to point B:

$$P=IV = 1.5^2 \times 9 = 20.25W$$

Transformers reduce power loss as they allow voltage to be stepped up and current to be stepped down as they are inversely proportional where power remains the same: $P=IV$. (reducing power loss in the form of heat or excess sound energy from buzzing).

Ohms Law:



Frequency = 1/period



Primary coil = 500 turns, secondary = 50/240 = 100 = 24 turns.

Shed light = 5W so, resistance of wires = $R=V/I = 5/0.5 = 10\Omega$

Power dissipated in wires = power loss
 $P_{loss} = I^2 R = 0.5^2 \times 10 = 2.5W$

Vce Physics Electricity

Mike Jess

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the name bar.

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Investigation of Reliability Aspects of Power Semiconductors in Photovoltaic Central Inverters for Sunbelt Regions

Christian Felgemacher, 2018-03-23 High reliability and system lifetimes in the range of 30 years are essential for renewable energy systems such as photovoltaic power plants to minimise costs for the generated electric energy At the same time such systems are used in regions with high solar irradiance and also harsh environmental conditions Therefore designs for photovoltaic inverters need to meet not only the key design criteria of high conversion efficiency but also need to be very robust and at the same time meet challenging cost targets In this dissertation aspects concerning the lifetime and reliability of power semiconductors in photovoltaic central inverters are investigated On key topic of the dissertation is the measurement of the voltage dependent failure rate due to cosmic radiation induced single event burnout of SiC and Si power semiconductors The second topic is the development of a system level simulation to quantify the stress on the power semiconductors in a PV central inverters in various regions of the world Further topics are the investigation of improved

control concepts for the cooling system of PV central inverters and the monitoring of IGBT temperatures during converter operation *Novel SiGe BiCMOS Device Physics Phenomena and Their Application to Power Amplifiers* Ningyue Jiang, 2006

The Electrical Engineer, 1910 *Semiconductor Power Devices* Josef Lutz, Heinrich Schlangenotto, Uwe Scheuermann, Rik De Doncker, 2011-01-15 Semiconductor power devices are the heart of power electronics They determine the performance of power converters and allow topologies with high efficiency Semiconductor properties pn junctions and the physical phenomena for understanding power devices are discussed in depth Working principles of state of the art power diodes thyristors MOSFETs and IGBTs are explained in detail as well as key aspects of semiconductor device production technology In practice not only the semiconductor but also the thermal and mechanical properties of packaging and interconnection technologies are essential to predict device behavior in circuits Wear and aging mechanisms are identified and reliability analyses principles are developed Unique information on destructive mechanisms including typical failure pictures allows assessment of the ruggedness of power devices Also parasitic effects such as device induced electromagnetic interference problems are addressed The book concludes with modern power electronic system integration techniques and trends **Physics for B.Sc. Students: Semester IV Perspectives of Modern Physics and Basic Electronics NEP**

2020 Uttar Pradesh P S Hemne & C L Arora, This book has been conceptualized as per the recommended National Education Policy NEP 2020 and as per syllabus prescribed by Universities of Uttar Pradesh for B Sc Students of Physics for the Fourth Semester This textbook comprehensively covers two papers Theory and Practical Part A begins with Structure of Space Time in Newtonian Mechanics Galilean Transformation and Electromagnetism Leading to the Foundation of Theory of Relativity is studied in detail The experimental background of Michelson Morley Experiment and its Significance of Discarding the Existence of either developed the relativistic kinematics Inadequacies of Classical Mechanics Black Body Radiation Max Planck s Quantum Hypothesis and Concept of Matter Waves are elaborately explained in a simple manner Part B deals with the electronics branch which covers transistor biasing amplifiers feedback and oscillator circuits are lucidly explained with suitable examples *Parallel Dynamic and Transient Simulation of Large-Scale Power Systems* Venkata Dinavahi, Ning Lin, 2022-01-01 This textbook introduces methods of accelerating transient stability dynamic simulation and electromagnetic transient simulation on massively parallel processors for large scale AC DC grids two of the most common and computationally onerous studies done by energy control centers and research laboratories for the planning design and operation of such integrated grids for ensuring the security and reliability of electric power Simulation case studies provided in the book range from small didactic test circuits to realistic sized AC DC grids and special emphasis is placed on detailed device level multi physics models for power system equipment and decomposition techniques for simulating large scale systems *Parallel Dynamic and Transient Simulation of Large Scale Power Systems A High Performance Computing Solution* is a comprehensive state of the art guide for upper level undergraduate and graduate students in power systems engineering

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