ANTENNA AND WAVE PROPAGATION

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Power Theorem & its Application to an Isotropic Source

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Maximum Power Transfer

- For any power source, the maximum power transferred from the power source to the load is when the resistance of the load R_L is equal to the equivalent or input resistance of the power source $(R_{in} = R_{Th} \text{ or } R_N).$
 - The process used to make $R_L = R_{in}$ is called impedance matching.





Application

- When developing new circuits for a known application, optimize the power transfer by designing the circuit to have an input resistance close to the load resistance.
- When selecting a source to power a circuit, one of the selection criteria is to match the input impedance to the load resistance.

Example Seen in ECE Labs

- Function generator on the Velleman oscilloscope that is used in a number of ECE lab classes. Measurements of V, the voltage across the load resistor R_L, can be well below the voltage specified on the function generator.
 - $R_{in} = R_{Th} = 40\Omega$
 - This is observed as R_L approad smaller than R_{Th}.





http://www.vellemanusa.com

Other Examples

- Selection of wire
 - Antenna wire is designed to match a 75 Ω load.
 - Coaxial cable is designed to act like a 50 Ω load.
- Most electronic and electrical equipment are designed to have an R_{Th} of 50 $\Omega.$
- The speakers used in some of the ECE labs are designed to act like an an 8 Ω load while microphones are designed to act like a 600 Ω load.
 - It is important that the resistance of the wire that runs to the speaker is very low or the power will be dissipated in the wire rather than used to create sound.
 - For best audio quality, the input impedance of the circuit connected to the speaker (or the microphone) should be equal to the resistance of the speaker (or the microphone).



Summary

 Maximum power transfer theorem is used frequently to insure that the greatest power can be transferred from a power source to a load.