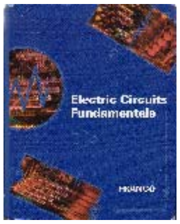

Electric Circuits Fundamentals

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DEVELOPING PHYSICAL INSIGHT AND INTUITION

(Some Thoughts on What Sets this Book Apart from the Competition)

The electric circuits discipline is based on the following steps: starting from the physical reality of a circuit, (*a*) it develops *conceptual models* for a rigorous and systematic description of the circuit, (*b*) it effects appropriate *mathematical manipulations* upon these models to analyze and predict circuit behavior, and (*c*) it interprets conceptual results in terms of *known physical behavio*r.

The last step is important for two reasons: (*a*) Since engineering is an applied discipline, the correctness of any conceptualization must ultimately be *tested against physical substanc*e, not mere abstraction as in the case of purely abstract disciplines; (*b*) Relating theory to practice helps the student develop a *feel for the physical operation of the circui*t, how its individual components interact and collaborate in of making the circuit work. An early development of *physical insight and intuition* benefits the student not only in subsequent courses such as micro-electronics courses, but also after graduation because this is how engineers function in the practice of their profession. This claim is made by someone who, before becoming an educator, has had significant experience in industry.

The motivation for writing this book stems precisely from the author's frustration with the insufficient attention devoted by current books to relating the theoretical back to the practical. Once the first step from the physical to the mathematical has been accomplished, the common trend seems to be that of confining the reader within the abstract realm. Though circuit theory is unquestionably a subject of intrinsic beauty, its advantages can be realized effectively only if we go the full cycle by closing the loop

physical $\rightleftarrows$ **mathematical**

Though this spirit is interspersed throughout the book and can be fully appreciated only through daily sage, the accompanying list provides a quick reference for the verification of the stated claims. If only

p. 66 top:	***Voltage divider approximations*** (elementary)
p. 362 center:	***Creating diverging responses*** (intermediate)
p. 619-620:	***Physical meaning of poles and zeros*** (advanced)

For a more detailed list of instances emphasizing physical insight, please refer to the following:

p. 8 top:	Physical operation of the potentiometer
p. 11 center:	Illustrating the active/passive sign conventions using power-transfer concepts
p. 29 center:	Hydraulic analogy for KCL
p. 32 top:	Hiking analogy for KVL
p. 42 center:	Hydraulic analogy illustrating the difference between voltage and current sources
p. 57-58:	Limiting cases for resistances in series
p. 59-60:	Limiting cases for resistances in parallel
p. 66 top:	Voltage divider approximations
p. 68 bottom:	Current divider approximations
p. 106-107:	Checking techniques in nodal analysis