

AE-237: OVERVIEW and Reading Assignments

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TEXT BOOK: Teach Yourself Electricity and electronics (**TYE+E**) by Stan Gibilisco (5th edition)

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You already have an organic grasp of how things work based on life and studio experiences. I hope this class will shed light on those everyday things you take for granted and how they work.

TYE+E is an easy-to-read text book – all things considered - that, if read one chapter per week, is a DIY basic electronics class that can be completed in nine months! Our class is only ten weeks, so obviously we're not going to explore the entire book, but we will cover four chapters per week for the first five weeks, focusing on the audio-specific aspects of electronics. You are encouraged to re-read the chapters as many times as you can.

Below you will find chapter summaries as well as a reading schedule. Absorb what you can. Don't get frustrated, but do try to correlate what is discussed in class and augment with web searches. Often a true understanding can only come from multiple perspectives and explanations that are combined with experience. In short, for every three hours of class time you should invest three hours of study time.

Chapter-1: Electronics, as taught in an Electrical Engineering program, includes a background in Chemistry and Physics - understand the materials used, how they behave, the laws and the math that govern them. Don't be intimidated by the opening chapter – every study of electronics must start somewhere. The key chapter headings are Electrons (page-4), and Conductors (page-8). Keep reading...

Chapter-2: Electric Units are defined from page-17 through page-32. The drawing (2-4, p.21), is the key to understanding how current is measured and calculated. This is the foundation of Electrical Concepts. Table 2-2 (p.24) displays the multipliers from pico (10 to the -12th power) and tera (10 to the 12th power).

Chapter-3: Before there were digital multi-meters, nearly measuring device had a meter. Now, analog meters are found on vintage and retro-style gear. Think about the earliest primitive human tools - a rock that evolved into a hammer, a sharp rock that evolved into a knife. As recently as 150 years ago, experimenters made many of their tools.

Chapter-4: This is the Law and Order chapter for **Direct Current** - what batteries and power supplies make by using chemical reactions to produce energy and by converting AC into DC, respectively. An introduction to Schematic Symbols and basic Circuit analysis using Ohm's Law and the Power formula.

Chapter-5: Lay down on Doctor Freud's couch for your first Circuit Analysis session. Series and Parallel Resistance formulas can predict the outcome of a circuit. The ending chapter topic is Voltage Divider networks - and if you've wondered what any of this has to do with audio, this is the heart of the LA-2, LA-3, LA-4 and UREI 1176.

Chapter-6: Viva La Resistance! Resistors were introduced way back in Chapter-2 and have appeared in every chapter since, but now we find out their purpose in our electronic lives. Resistors are passive "static" devices, they can divide a signal but they can not multiply. That's active territory, such as our dynamic, thermionic friends the vacuum tube and their solid-state cousin the transistor. In order for these active devices to function, we must bias them using resistors to establish their operating parameters. The resistor Color Code and Logarithms are introduced.

Chapter-7: Remember Law and Order? Well this chapter has you as the lawbreaker, so let's walk into the cell quietly and no one will get hurt. Actually, the topic is those chemically active DC power sources, the cell and the battery.

Chapter-8: It don't mean a thing if it ain't got that cling. Magnetically speaking, that is, the force is all around us, like in your iPod's hard disk, the stripe on your credit card and in those vintage analog beasts, the recorder-reproducers (tape recorders and disc cutting lathes). Magnetism works in both DC (battery and power supply) and AC (sound and wall-power) domains.

Chapter-9: Sound pressure converted to an audio signal is an Alternating Current just as a wind-water-steam turbine connected to an alternator converts physical motion into electricity for our power distribution system. DC is to Edison as AC is to Tesla, just as DC is to Resistance as AC is to Impedance.

Chapter-10 (Inductance) and –11 (Capacitance): You recall the resistor and how to calculate series and parallel circuits? Well, when you read Chapters 10 and 11, there are specific pages - detailed below – that will help you see the similarities in terms of how Inductance (in Henries) and Capacitance (in micro-Farads or μF) combines in Series and Parallel.

All of the DC stuff we've learned so far has been two-dimensional – X and Y axis parameters like Volts and Resistance, Current and Volts, etc. AC adds a third dimension - the Z axis (imaginary numbers) via Inductors (ch-10) and Capacitors (ch-11). These **re-active** components add to our arsenal of electron manipulators. You'll want to google the old-skule geek memory trick "ELI the ICE man" (see p.219 for ELI and p.235 for ICE).

The best example of how DC Resistance (Ω) becomes AC Impedance (ω) - both in ohms – is a loudspeaker's voice coil. By itself, the wire used to make a voice coil has a definable resistance per foot (meter). When wound into a coil, that wire becomes inductive - it's resistance changes with frequency – and gains MASS when mounted to a cone. At the top, the cone is secured to the basket by the visible surround around its circumference. Below, the coil is precisely centered in the magnetic field by the 'spider.' Together, the suspension and the surround create a spring that, in conjunction with the cone's MASS, has a resonant frequency, or Free Air Resonance (**F_s**). (See Table-1)

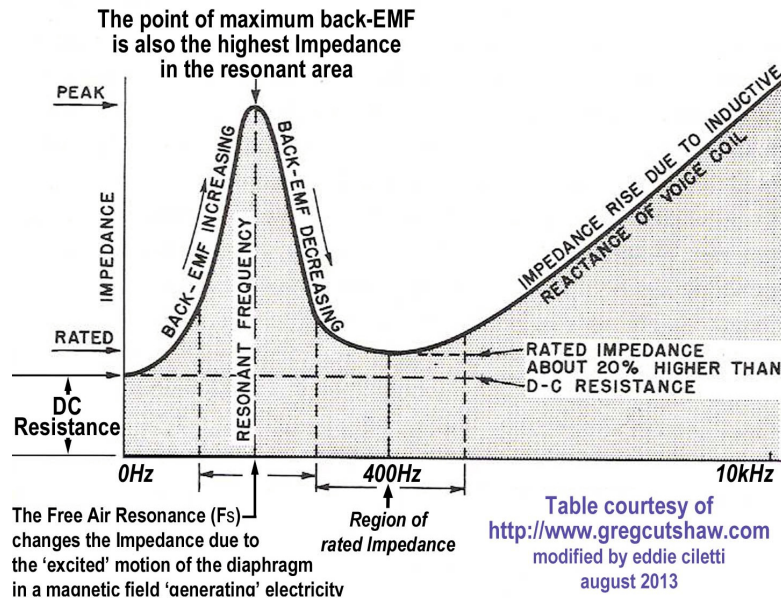


Table-1: Typical Impedance Curve for a low-frequency drive (woofer)

Chapter-12: You will be phased, chorused and flanged in this chapter.

Chapter-17: If you are building a studio and need to determine the amount of power that will be consumed, then this is required reading.

Chapter-18: If you've ever gone on a blind date then you should check out this informative chapter on Impedance matching. It's particularly applicable to old school gear like mic preamps and outboard gear.

PART-3 Basic Electronics: Up until this point we've been studying Electricity. But now, but according to the book, Basic Electronics starts here.

Chapter-19: Semiconductors are not part-time Light Rail engineers, but instead are those solid-state devices that were developed by Bell Labs and are the reason we can have cell phones.

Chapter-20: Diodes, the most basic of semiconductors, only pass current in one direction. This is useful when converting AC-to-DC, illumination (Light Emitting Diodes = LEDs) and clipping (fuzz boxes).

Chapter-21: Supplies, Supplies, Surprise! Now that we know how to convert AC to DC, it's time to dig in and build one to power our project.

Chapter-22 and -23: Semiconductors come in many flavors, the Bipolar Transistor and the Field Effect Transistor being two of them. Our class project - a solid-state preamp - is based on these building blocks.

Chapter-28: The Operational Amplifier (opamp) was the first analog computer. It can add, subtract and multiply. Don't think that applies to audio? Think mixer (summing), balanced input (noise rejection) and mic preamp (gain = multiplication).

Chapter-29: Yes, we still use vacuum Tubes!

**** Please note that while the readings are selective, you should look at all the pictures throughout the chapters.**

week-1: Physics, Chemistry, Electrical Units and DC Basics Ch. 1: pp.03-14 Ch. 2: pp.17-32 Ch. 3: pp.35-50 Ch. 4: pp.54-65	week-2: DC Circuit analysis, Resistors, Cells / Batteries and Magnetism Ch. 5: pp.69-84 Ch. 6: pp.89-98 Ch. 7: pp.106-115 Ch. 8: pp.119-134	week-3: AC Basics, Inductance Capacitance and Phase Ch. 9: pp.151-165 Ch. 10: pp.170-174 ** Ch. 11: pp.185-194 ** Ch. 12: pp 200 ~ all pix, but especially pix 12-9 (lead), 12-10 (lag)
REACTANCE: ELI the ICE man For Inductance... ELI = Voltage <i>leads</i> Current – p219 “L” is the abbreviation for Inductor For Capacitance ICE = Current <i>leads</i> Voltage – p 235 “C” is the abbreviation for Capacitor	week-4 AC Power, Transformers, Semi-conductors and Power Supplies (PSU) Ch. 17: pp 282 – 286 power factor = VA = Watts Ch. 18: pp.304 - 314 Ch. 19: pp. 335-341 Ch. 20: pp. 345 – 353 Ch. 21: pp. 358 - 370	week-5: Mid-Term
Week-6: Amplification Transistors and FETs Ch. 22: pp. 374-384 Ch. 23: pp. 389 – 399	Week-7: Amplification and the Decibel Ch. 24: pp. 404 - 410 Ch. 24: pp. 413 - 415	Week-8: Integrated Circuits (ICs) – augment with OpAmp link and Vacuum Tubes Ch. 28: pp. 525 – 534 Ch. 29: pp 538 – 545

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