# Polk County Amateur Radio Association
# 2010 General Class Study Guide
# Lessons 9 thru 12
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Week 3 - February 20th - Lessons 9 - 12

Lesson 9 - "Reactance and Resonance"

- Chapter 4, pp 4-18 to 4-21
- Define Reactance “The resistance of ac current by a capacitor or inductor” Page 4-18
- What occurs when the frequency of an ac signal increases through a coil (inductor)? Does the reactance increase or decrease? Page 4-20
- So what happens with the frequency of an ac signal increases through a capacitor? Does the reactance increase or decrease? Page 4-19
- What unit of measure is used for reactance? 4-18
- What unit of measure is used for impedance? 4-18
- You can define impedance as: “The opposition to current flow in a ac circuit. Capacitive reactance, inductive reactance and resistance are all types of impedance. Page 4-20
- Maximum power transfer occurs when the source and load impedances are equal. Like a transmitter output to an antenna. Page 4-21
- Core saturation of an impedance matching transformer can occur at high power. This can cause signal distortion and harmonics. Page 4-22
- Impedance matching transformers are used to equalize impedances… so maximum power can be transferred. Page 4-21
- The following components are often used in impedance matching: transformer, Pi-network, a length of transmission line. Page 4-21
- An “LC” network is the combination of an inductor (L) and capacitor (C). How are these networks used to transform impedance? Page 4-21

Lesson 10 - "Semiconductors, ICs, and Digital"

- Chapter 4, pp 4-22 to 4-29
- Define PIV, Peak Inverse Voltage. This is the rating of a diode. What does it mean? Why should you not exceed the PIV rating in a circuit? Page 4-22
- A silicon diode is also rated by the amount of average forward current it can handle. If more current is passed through a diode, heat builds up. Then what? Page 4-22
- The amount of voltage required to force electrons across a diode’s junction is called the “forward voltage” of the diode. Those made of silicon = .7v and those made of germanium is .3 v  Page 4-22
- Why are Schottky diodes used at high frequencies? Like in an rf switching circuit? Because of the low capacitance of the junction. Page 4-23
- A bipolar transistor (PNP or NPN) has two stable operating points when used as a switch: Saturation, or all the way ON, and cut-off region, or all the way OFF. Page 4-24
- Large power transistors have to be insulated so they don’t short to ground. Why? The collector (the case) transfers heat. Page 4-25

- A “metal-oxide-semiconductor FET” or MOSFET are very sensitive and have an insulating layer of oxide between the gate and the rest of the transistor. Page 4-24
- Be able to identify the schematic diagram of an NPN and PNP transistor. Hint: Think of NPN as Not Pointing iN, then the reverse is true for PNP. Page 4-23
- The most common ANALOG integrated circuits (IC’s) are the operational amplifier (OP-AMP) and the linear voltage regulator. Page 4-25
- The most common digital logic family of IC’s are the CMOS type due to their high speed and low power consumption. Page 4-27
- Flip-flops have two stable states, on or off… until something changes! Pages 4-25 & 4-26
- AND and NAND gates have two logic inputs and one logic output. Page 4-26
- OR and NOR gates have two logic inputs and one logic output. Page 4-26
- How many states are there in a 3 bit binary counter? $2^3$ equals 8. Page 4-27
- Just what is an MMIC? It is a Monolithic Microwave Integrated Circuit. They are found everywhere because they perform several functions and are low cost. Page 4-27
- ROM = Read-Only Memory. Stores data and cannot be changed. Page 4-28
- Memory that is non-volatile means it will keep its data even when the power is disconnected. Volatile memory will lose its data. Page 4-28
- The USB (Universal Serial Bus) is used to connect a transceiver to a computer. Page 4-29
- LED (Light Emitting Diode) is a replacement to the light bulb, they are cheaper, last longer, turn on/off quicker and use less power. They emit light when they are FORWARD biased. Page 4-29
- LCD (Liquid Crystal Display) are designed to block light to create characters, thus they need to have either back light or ambient light. LCD’s do not generate light of their own. Page 4-29

Lesson 11 - "Power Supplies, Batteries, Connectors, and Test Equipment"

- Chapter 4, pp 4-30 to 4-44
- To increase the forward current capability of diodes, they are placed in parallel. A low value resistor is inserted in series with each diode to “equalize” the current between the diodes. Page 4-32
- Know why it’s important to include a “bleeder resistor” in your power supply design. They are a safety feature that discharge stored energy from capacitors. Page 4-33
- Power supplies have three basic parts: an input transformer, a rectifier, and a filter-regulator output circuit. Page 4-30
- The PIV rating of the rectifier in a full-wave power supply must be double the normal peak output voltage. Page 4-31
- Switching power supplies require capacitors with low ESR and ESL. What is ESR and ESL and why are they used in switching supplies? Page 4-34
- Switching power supplies are much smaller than linear supplies. Why? Page 4-34
- A half-wave rectifier converts half of a cycle to DC. If there is 360 degrees in one cycle, a half cycle is 180 degrees. Page 4-30
- And, a full-wave rectifier converts all of the cycle to DC. Page 4-30
- A full-wave rectifier will produce DC pulses at twice the frequency of the AC input. Why is this and why is this method used? Page 4-30

- Be aware that when you charge a lead-acid battery, explosive hydrogen gas may be released. Be sure the area is well ventilated. Page 3-36
- An advantage of using NiCd batteries is their low internal resistance which results in high discharge current. Page 4-35
- A battery can produce useful power until the output drops to approximately 10.5 volts. Study Page 4-35 to find out why.
- A primary battery is never to be recharged. They are made from carbon-zinc, alkaline and silver-nickel. They are an excellent source of emergency power. Page 4-34
- Photovoltaic conversion is the process of converting sunlight directly into electricity. Look at the word, Photo-volt-aic. Page 4-36
- A well illuminated photovoltaic solar cell produces about .5 VDC in a open circuit. It takes a lot of these to do useful work! Page 4-36
- A Type-N RF connector is both moisture resistant and useful to 10 GHz. Page 4-39
- The DB-9 is a popular serial data connectors. Most newer computers have eliminated this port and substituted USB instead. However, the venerable DB-9 continues to be used quite a bit in ham radio. Page 4-39
- Why do they call a PL-259 a UHF connector. It's only used up to 150 MHz. Page 4-39
- An RCA Phono plug and jack is still used today as an audio connector. Page 4-38
- What is meant by a "keyed" connector? Page 4-37
- Digital volt meters are both significantly more precise than an analog meter and offers a high input impedance so you don't load down the circuit under test. Page 4-41
- An oscilloscope contains both horizontal and vertical channel amplifiers. This makes it possible to read complex waveforms. Page 4-41
- A special purpose type of scope is a Monitor Scope and used in the shack. Page 4-41
- Signal tracers are used primarily to identify nonfunctioning circuits or stages in receivers. Page 4-42
- A noise bridge is a useful test instrument and is used by connecting it between a receiver and an antenna of unknown impedance and adjusted for minimum noise. Page 4-43
- A dip meter is used to measure the resonant frequency of a circuit. Page 4-43
- Antenna analyzers perform the work of several test devices. By connecting it to a feedline and antenna system you can test for SWR. Page 4-43
- Relative RF output of an antenna is usually measured with a field-strength meter. Using a field-strength meter compliments your SWR and Power Meter. You can also measure the radiation pattern of an antenna. Page 4-44
- Directional watt meters can measure Standing Wave Ratio (SWR). Page 4-44

Lesson 12 - "Radio Signals"

- Chapter 5, pp 5-1 to 5-7
- Amplitude Modulation (AM) changes the envelope of the RF wave to convey information. Page 5-1
- Single Side Band (SSB) allows more power to be placed into the remaining sideband after the carrier and one sideband is suppressed. SSB also uses less bandwidth. Page 5-2
- Phase Modulation (PM) is the process that changes the phase angle of an RF wave to convey information. Page 5-2
- Frequency Modulation (FM) is the process that changes the frequency of an RF wave to convey information. Page 5-2

- The carrier frequency changes proportionally to the instantaneous amplitude of the modulating signal in an FM transmitter. Page 5-2
- When transmitting digital modes, the duty cycle is at or about 100% thus you must reduce your power to half or lower to save your finals. Page 5-4
- When transmitting RTTY, use LSB for all bands. This is the normal convention. Page 5-5
- RTTY can be described as having a 5-bit code with an additional start and stop bit. Remember how we defined the term “baud?” Page 5-4
- Do you know the standard “shift” between frequencies used for RTTY? Page 5-5
- The faster the symbol rate (keying rate) the greater the frequency shift is required. Why is that? Page 5-4
- Do you know how many data bits are sent in a single PSK31 character? Page 5-5