LEWIS CLARK STATE COLLEGE

Industrial Electronics Tool List

Required Tools

- Mechanical Pencil and Eraser — $5
- Permanent Marker — $5
- Scientific Calculator* — $25
- Personal Computer* — $300
- Multimeter* — $50–$400
- USB "Flash" Drive — $10
- USB-Based Oscilloscope* — $190
- Solderless Breadboard (e.g. Busboard BB830) — $10
- Alligator-Clip Jumper Wires (package of at least ten) — $10
- Slotted Screwdrivers (1/8", 1/4") — $10
- Phillips Screwdrivers (#1, #2) — $10
- Jeweler's Screwdriver Set — $10
- Wire Strippers, 18–24 AWG — $10
- Needle-Nose Pliers — $10
- Diagonal Wire Cutters — $20
- Metal Rule (inches & mm) — $10
- Batteries: 6 Volt and 9 Volt — $15
- Illuminated Jeweler's Loupe — $15
- Safety Glasses — $10
- Soldering Iron (pencil-tip), 30 Watts or less — $25–$100
- Tube/Spool of Rosin-Core Solder* — $15

***Scientific calculator** – at minimum your calculator must perform trigonometric functions (sine, cosine, tangent, etc.), offer multiple memory registers, and display values in both scientific and "engineering" notations. I recommend either the Texas Instruments model TI-36X Pro or the Casio model fx-115ES because they easily perform complex-number arithmetic necessary for AC circuit analysis and are inexpensive.

***Personal computer** – we use computers every day for applications such as teleconferencing software (e.g. Zoom), document reading and creation, coding, and circuit simulation. Having your own portable computer is therefore essential. Most operating systems, hard drive capacities, RAM memory sizes, and screen sizes are appropriate, but your computer must have a keyboard and mouse (i.e. no tablets).

Avoid ChromeBooks. Useful but non-essential features include an RJ-45 Ethernet port and multiple USB ports.

***Multimeter** – this is your first and most important electronic test instrument. At minimum it must measure DC and AC voltage, DC and AC current (milliAmpere range), resistance, and "diode check" voltage drop. Cost is a strong function of accuracy, additional features, frequency range, and safety ("Category" ratings for over-voltage exposure). The Fluke model 17B+ is an excellent choice for digital multimeters, and the Simpson 260 is an excellent professional-grade choice for analog multimeters. The best minimal-cost multimeter I've found is the model DT-830B which sells for less than $20, with the test leads being the weakest component (but easily upgraded).

***Oscilloscope** – entry-level USB-based oscilloscopes now cost less than a textbook. Pico Technology is an excellent brand, and their model 2204A comes with high-quality probes as well. Plugged into your personal computer using a USB cable, the Picoscope turns your computer's monitor into a high-resolution oscilloscope display. Features include two measurement channels, 10 MHz bandwidth, built-in arbitrary waveform generator (AWG), ± 100 Volt over-voltage protection, digital "cursors" for precise interpretation of amplitude and frequency, meter-style measurement capability, Fast Fourier Transform algorithm for frequency-domain measurement, export ability to several graphic image formats as well as comma-separated variable (.csv) files, and serial communications signal decoding. Together with your multimeter, solderless breadboard and Development Board (which you will construct in the IETTI-102 Project course and is yours to keep) this forms a complete electronics laboratory for doing experiments and projects outside of school.

***Soldering** – the equipment you purchase for soldering need not be expensive, if you purchase the right solder. For electronics work you must use rosin-core solder. Kester is an excellent brand, and you should avoid cheap imported solders. For lead-based solder, a 63% tin and 37% lead alloy (Sn63/Pb37) works very well. A one-pound roll is likely more solder than you will need in these courses, so I recommend buying just a small tube instead. I recommend a fine-tipped soldering iron (15 Watts continuous power, although some with adjustable temperature controls may have higher power ratings to get up to soldering temperature more quickly) and a solder diameter 0.031 inches or smaller for doing fine printed-circuit board work. Also, keep the tip of your soldering iron clean by wiping it against a damp sponge or paper towel when hot, and not leaving it hot any longer than necessary. Hakko, X-tronic, and Lonove are all recommended brands.

Additional tools will be needed as you advance through the program depending on your emphasis.