PHY 305F – ELECTRONICS LABORATORY I
Fall Semester 2003
LAB OUTLINE (may be subject to change)

Experiment 1 – Realities of Passive Circuits and Meters – 2 weeks
- Learn to use work station equipment, do various I vs. V curves, use a voltage divider, measure a Thévenin equivalent resistance of a signal generator, observe the frequency and waveshape responses of their meters, measure transfer characteristics vs. frequency of an RC circuit.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on September 29.

Experiment 2 – LCR Resonant Circuits and the Quality Factor Q – 1 week
- Investigate LCR resonant circuits and understand the quality factor, Q.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on October 6.

Experiment 3 – Transmission Lines – 1 week
- Deal with characteristic impedance, attenuation, and the effects of a termination.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on October 20.

Experiment 4 – Digital Devices, Gates, and Flip-Flops – 2-3 weeks
- Study various TTL logic gates, and S-R and J-K flip-flops.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on November 3.

Experiment 5 – Operational Amplifiers – 2 weeks
- Investigate a 741 op-amp in various configurations: open loop, inverting amplifier, unity gain amplifier, integrator. Also look at gain, frequency response, offsets, bias current, and slew rate.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on November 17.

Experiment 6 – Power Supplies – 1 week
- Investigate diode rectification, smoothing, and voltage regulator packages.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on November 24.

Experiment 7 – Electronic Noise – 1 week
- Study the various types of electronic noise in the lab.
- Lab notebook due at 1 PM (i.e., before the start of the next experiment) in MP238 on December 1.

Experiment 8 – Transistors and Transistor Amplifiers – 1 week
- For a single JFET, measure and analyze I_D vs. V_{GS} characteristics, and so find I_{DSS} and V_P. Put the JFET in an amplifer circuit, measure gain, and confirm that the transconductance matches the measured parameters.
- For a single BJT CB amplifier, the frequency response is observed. Then the circuit is treated as a constant current source. Look at a long tailed pair with resistive emitter resistor and finally look at the same circuit with the CB amplifier collector as the emitter "resistor".
- Lab notebook due by 5 PM in MP710A on December 8.

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Fall Semester 2003
LECTURE OUTLINE (may be subject to change)

1. **DC Circuit Basics: Passive and Linear Components and Circuits**
   - Linear circuits, power sign conventions, real vs. ideal devices and sources, Kirchoff's Laws, network analysis techniques (branch, loop, and nodal analysis), principle of superposition, equivalent circuits, Thévenin and Norton Theorems
   - The use of meters, and their frequency, loading, noise, and waveshape limitations
2. **AC Circuit Basics: Passive and Linear Components and Circuits**
   - Brief review of complex numbers and Fourier analysis
   - One-port (two-terminal network): transient responses, steady (sine wave) responses, impedance, various L, C, R combinations, resonant circuits, Q
   - Power in AC
   - Two-port networks: voltage dividers, L, C, R combinations
   - Transformers and transmission lines
3. **Digital Basics: Combinational Logic**
   - Gates (what they do, how they work)
   - Families of logic devices, characteristics, delays
   - Combinational logic design, Karnaugh maps, logic minimization
4. **Digitial Basics with Time Added: Sequential Logic**
   - Flip-flops (SR, gated SR, JK)
   - Shift registers, counters, timing and delays, multiplexing
5. **The Analogue Package: Op-Amps and Their Applications**
   - Dependent sources
   - 741 op-amp: all its characteristics (an introduction to the behaviour, characteristics, and limitations of op-amps), slew rate
   - Simple inverting amplifier, integrator, summing, follower, and non-inverting amplifiers
   - Types of negative feedback: current or voltage derived, series or shunt fed, and effects on gain, input, and output impedance
6. **Nonlinear Aspects of the Analogue World: Diodes and Nonlinear Applications**
   - Diode characteristics for ideal diode, pn junction diode, vacuum diode
   - The pn junction – a very brief description of how it works
   - Equivalent circuits which approximate real diodes
   - Rectification: half wave, full wave
   - Peak detector, AM signal, and detection
   - Zener diodes, regulators, voltage regulator packages
7. **Noise**
   - Noise sources, grounding and shielding, ground loops
8. **The Discrete Building Block: Transistors and Transistor Amplifiers**
   - How FETs work, characteristics of JFETs and BJTs
   - Simple FET applications – characteristics of these circuits