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## Laboratory Exercises *(a more detailed listing)*

### PART I: ANALOG LABS

- Lab 1.     **DC Circuits**  
 Ohm's law; A Nonlinear device; The diode; Voltage divider; Thevenin model;  
 Oscilloscope; AC voltage divider
- Lab 2.     **Capacitors**  
 RC circuit; Differentiator; Integrator; Low-pass filter; High-pass filter; Filter example  
 I; Filter example II; Blocking capacitor; LC filter
- Lab 3.     **Diodes**  
 LC resonant circuit; Confirming Fourier series; Half-wave rectifier; Full-wave bridge  
 rectifier; Ripple; Signal diodes; Diode clamp; Diode limiter; Impedances of test  
 instruments
- Lab 4.     **Transistors I**  
 Transistor junctions are diodes; Emitter follower; Transistor current gain; Current  
 source; Common emitter amplifier; Transistor switch
- Lab 5.     **Transistors II**  
 Dynamic diode curve tracer; Grounded emitter amplifier; Current mirror; Ebers-Moll  
 equation; Biasing: good & bad; Push-Pull
- Lab 6.     **Transistors III**  
 Differential amplifier; Bootstrap; Miller effect; Darlington; Superbeta
- Lab 7.     **Field Effect Transistors I**  
 FET characteristics; FET current sources; Source follower; FET as Voltage-  
 controlled resistance; Amplitude modulation; 'Radio broadcast'
- Lab 8.     **Op Amps I**  
 Op-amp open-loop gain; Inverting amplifier; Non-inverting amplifier; Follower;  
 Current source; Current-to-voltage converter; Summing amplifier; Push-pull  
 buffer
- Lab 9.     **Op Amps II**  
 Op-amp limitations; AC amplifier; Integrator; Differentiator; Active rectifier; Active  
 clamp
- Lab 10.    **Oscillators**  
 Comparator; Schmitt trigger; IC relaxation oscillator; Sawtooth wave oscillator; ;  
 Voltage-controlled oscillator; Wien bridge sine oscillator; Unwanted oscillations:  
 discrete follower & op amp stability problems
- Lab 11.    **Field Effect Transistors II**  
 Analog switch characteristics; Applications: chopper circuit; sample-&-hold;  
 switched-capacitor filters; negative voltage from positive
- Lab 12.    **Power Supplies**  
 The 723 regulator; Three-terminal fixed regulator; Three-terminal adjustable  
 regulator;  
 Three-terminal regulator as current source; Voltage reference; 'Crowbar' clamp

*PART II: DIGITAL LABS*

- Lab 13. **Gates**  
 Logic probe; IC gates: TTL & CMOS; Logic functions with NANDs; Gate innards:  
 TTL; CMOS: CMOS NOT, NAND, 3-state
- Lab 14. **Flip-Flops**  
 Latch; D flop; J-K flop; Ripple counter; Synchronous counter; Shift-register;  
 Digitally-timed *one-shot*
- Lab 15. **Counters**  
 8-bit counter; Cascading; Load from keypad; Programmable divide-by-n counter;  
 Period meter; Capacitance meter
- Lab 16. **Memory; State Machines**  
 RAM; Divide-by-3 (your design); Memory-based state machines: Single-loop;  
 External control added
- Lab 17. **A/D; Phase-Locked Loop: Two Digital Feedback Machines:**  
 D/A; A/D: Slow motion; Full speed; Displaying search tree; Speed limit;  
 Latching output; Phase-Locked Loop: frequency multiplier.
- Lab 18.  **$\mu$ 1: Adding CPU**  
 Clock; CPU preliminary test; Fixing *busgrant\**; Memory enable logic; Memory write  
 logic; Single-step; Test program; Full-speed: timing diagram
- Lab 19.  **$\mu$ 2: I/O: Output: First small programs**  
 Battery backup; Power-fail detector; I/O decoder; Data displays; Timing program
- Lab 20.  **$\mu$ 3: Input; More small programs**  
 Delay as subroutine; Improved delay routines; Input hardware: Data input hardware;  
 Input/output program; Ready signal; I/O program with enter/ready function;  
 Decimal arithmetic
- Lab 21.  **$\mu$ 4: A/D  $\longleftrightarrow$  D/A**  
 A/D-D/A wiring details; Programs: confirming that D/A, A/D work; In & Out;  
 Invert, rectify, low-pass;
- Lab 22.  **$\mu$ 5: 'Storage scope;' Interrupts & other 'Exceptions'**  
 'Storage scope;' keyboard control;  
 Exceptions: A software exception: illegal; Interrupt: hardware to request interrupt;  
 Program: main & service routine; NMI; Applying interrupts  
**Register-Check:** a debugging aid (optional program; install if you choose to)
- Lab 23. **Applying Your Microcomputer ('Toy Catalog')**  
 X-Y scope displays; Light-pen; Voice output; Driving a stepper motor; Games;  
 Sound sampling/generation