

Physics 3330-3340 Sample Projects 1986-1998

Electronic Instruments, Measuring and Control Devices

- Digital Clock or Stopwatch
- Digital Voltmeter
- Digital Capacitance Meter
- Semiconductor Temperature Sensors
- Logic to Identify Particles in a High Energy Physics Mock-up Experiment
- Traffic Light Control Circuit with Model of Intersection

Circuits and Signal Processors

- A Radio
- Digital "Mastermind Game "
- Field Effect Transistors
- ADC (Analog to Digital Converter)
- Precision Dual Slope ADC
- Digital Signal Storage
- Analog Signal Storage
- A to D to A Converter
- Spectrum Analyzer
- A Digital Readout Clock
- Digital Echo Box
- Digital Chess Clock
- Lamp Ping-Pong Scorer
- Digital Adder
- TI-04: The Power of an Abacus in the Palm of Your Hand
- Digital Tachometer
- FM Transmitter
- A Digital Combination Door Lock
- Radio Controlled Servo
- Decade Random Number Generators: The One Armed Bandit
- Serial Communication System
- Frequency Multiplier and Data Acquisition System
- Very Low Frequency Radio Receiver
- Proximity Alarm
- Simon Says
- AM Transmitter
- Event Counter
- Glitch Counter

Voice and Music

- Electric Guitar and "Fuzz Phase "
- An Octave Pedal for a Guitar
- LED Audio Voltage Meter
- Voice Record/Playback
- Simple VCO Keyboard
- Laser Microphone
- Voice Transmission by Light Waves
- AM Radio Transmission and Reception
- Audio Information Recording and Playback
- Voice Annunciator
- Synthesizer
- Multi-key Square Wave Synthesizer
- Visual Interpretation of Music with Spectrum Analyzer
- Phase-shift Pedal
- Visual Display of Music
- The Vocorder
- The Electronic Synthesizer and the Major C Pentatonic Scale

Audio-Optical Link
Optically Controlled Music Box
Theramin
Digital Delay Processor
Seven Band Graphic Equalizer
Musical Light Show
Sound Meter

Use of Electronic Models to Understand Physical Systems

Analog Computer for Forced Damped Harmonic Oscillator
Weakly Coupled LC Oscillators
Strongly Coupled LC Oscillators
Multiple Coupled Oscillators
Analog Computer for the Van der Pol Oscillator
Magnetic Flux in Matter
Silicon Oscillator

Medical Electronics

EKG Heart Monitor
Brain Wave Monitor
Blood Pressure Pulse Velocity
A Real-Time Monitor of Heart Rate Variability

Artificial Intelligence

Neural Networks - Networks of Op-Amps hat can Learn to do Tricks!
Neural Network Analog Knee

Measuring Things

Digital Thermometer
Light Intensity Display for UV/Ozone Monitoring
Thermal Conductivity of Gases by the Hot Wire Method
Measurement of the Dielectric Constant of Water
Friction of Bicycle Wheel
Star Tracker
A Magnetometer for Small Fields
Magnetic Flux in Matter
Thermal Noise of an Oscillator

Light

IR Motion Detector
Integrating Photometer
Clorox Laser
Optical Communications Link
Solar Powered Rechargeable Battery System and Yard Light
Photon Flux from the Sky
Optical Density Monitor
Ellipsometry System
Laser Scanner

Mechanics

Electromagnetic Pendulum
Comparison of Simple with Rigid Bar Conical Pendula
Precession of the Elliptical Pendulum
Measure Motion of a Silicon Torsional Oscillators
A Stepper Motor

Semiconductors

Band Gap Energy in Silicon from the Temperature Dependence of Transistor Current
T Dependence of Resistivity: Energies of the Band Gap and Acceptors of p-type Silicon
Hall Effect in p- and n-type : Sign and density of Charge Carriers
Photo-injection of Carriers: Mobility and Lifetime of Carriers in p-type Silicon
Properties of a Solar Collector Foil

Superconductors Ferromagnetics and Fundamental Noise

High Temperature Superconductivity: Meissner Effect, Critical Temperature and Current
Curie Point for Ferrite from the Temperature Dependence of a Ferrite Inductor
Boltzmann's Constant from the Temperature Dependence of Noise from a Resistor
Sheet Resistance of Thin Gold Films

Chaotic Phenomena in Non-Linear Electrical Systems

Tri-linear Active Circuit Element (Moon, "Chaotic Vibrations," Wiley (1987) pp 109-110)
Forced Chaotic Oscillations in Circuits Containing a Non-linear Inductor (Moon, page 140)
Chaos in Forced Oscillations of a Resonant Circuit Containing a Diode
Spontaneous Chaotic Oscillations in Circuits Containing Tunnel Diodes
Strange Attractors and Chaos in Non-linear Oscillating Circuits
Chaotic Phenomena in Dripping Water
Chaotic Response of a Nonlinear Oscillator with a Tri-linear Element

Electromagnetic Waves and Fields

1 GHz Electromagnetic Waves Radiated by Electric Dipole and Magnetic Dipole Antennas
Generation and Properties of Microwaves and their Transmission through Waveguides
Pulses and waves on Coaxial Cables
Electrostatic Potential Distribution measurement using an Electrolytic Bath
Magnetic Propulsion Rail Gun
Magnetic Field Distortion Detector
Shock Generator

Miscellaneous

The Weenie Wagon and the Tube of Doom
Remote Controlled Car
Fuses for Explosives
Tutbot: A Robot, A Journey, A Dream
Global Positioning Receiver