WTCS Electrical Engineering Technology Transfer Outcomes
Outcome Overview (1-23)

Updated 11.4.16

Fundamental Transfer Outcomes (1-17)

1. Circuit Fundamentals 1
    a. Utilize electronics terminology, schematic symbols, SI units of measure, and standards appropriately
    b. Explain Voltage, Current, and Resistance
    c. Explain DC voltage and DC current sources
    d. Identify basic electrical components and their voltage - current relationships
    e. Sketch basic electrical circuit schematics and wiring/pictorial diagrams
    f. Assemble basic circuits from circuit schematics, wiring diagrams, and/or specifications
    g. Measure basic DC electrical quantities (Voltage, Current, Resistance)
    h. Calculate component voltages and currents in basic DC electrical circuits
    i. Calculate power in basic DC electrical circuits.

2. Circuit Fundamentals 2
    a. Analyze series DC resistive circuits
    b. Analyze parallel DC resistive circuits
    c. Analyze series-parallel DC resistive circuits
    d. Measure basic electrical parameters in DC resistive circuits
    e. Troubleshoot DC resistive circuits

3. Circuit Fundamentals 3
    a. Apply DC Thevenin and Norton Equivalent Circuits
    b. Analyze DC circuits with multiple sources using Superposition
    c. Analyze DC circuits using Nodal Analysis (KCL & Ohm's Law)
    d. Analyze resistive bridge circuits

4. Circuit Fundamentals 4 DC-AC
    a. Define the mathematical parameters of sinusoidal AC signals and the math relationships among them
    b. Determine the performance of resistors in AC circuits
    c. Determine the performance of capacitors in DC circuits
    d. Determine the performance of capacitors in AC circuits
    e. Explain basic principles of magnetism and electromagnetism
    f. Determine the performance of inductors in DC circuits
    g. Determine the performance of inductors in AC circuits
    h. Apply college algebra and trigonometry to sinusoidal circuit analysis (phase vectors)
    i. Examine the response of transformers to AC sinusoidal stimulus

5. Circuit Fundamentals 5 DC-AC
    a. Analyze series RL and RC circuits using phasor analysis
    b. Analyze parallel RL and RC circuits using phasor analysis
    c. Analyze the ideal Series RLC circuit using phasor analysis
    d. Analyze the ideal Parallel RLC circuit using phasor analysis

e. Analyze series-parallel AC circuits using phasor analysis
f. Measure electrical parameters in AC circuits using an oscilloscope
g. Troubleshoot AC (RLC) circuits

6. Circuit Fundamentals 6 DC-AC
    a. Derive AC Thevenin and Norton Equivalent Circuits for basic AC circuits
    b. Analyze basic AC circuits with multiple sources using Superposition
    c. Analyze basic AC circuits using Nodal Analysis (KCL & Ohm's Law)
    d. Analyze AC bridge circuits
    e. Construct Bode approximations of frequency response for four basic filter circuits (series RL, LR, RC, & CR)
    f. Determine the resonant frequency response of the ideal series RLC circuit
    g. Determine the resonant frequency response of the ideal parallel RLC circuit
    h. Determine the resonant parameters of the practical parallel RLC circuit
    i. Document analysis and measurement according to standard practice

7. Diodes and Rectifiers
    a. Explain the operation of diodes
    b. Determine the operation of diodes in rectifier circuits
    c. Evaluate operation of special purpose diodes (including LED, Zener, and Schottky)
    d. Evaluate the operation of diode clippers and clampers

8. Power Supply Circuits
    a. Analyze capacitor operation in power supplies
    b. Evaluate Zener diode regulators
    c. Evaluate three terminal regulators
    d. Test power supply operation

9. MOSFET/JFET Characteristics/Basic Operation
    a. Explain the operation and operating regions of JFET and MOSFET devices
    b. Apply the JFET/MOSFET as a switch
    c. Predict bias values in JFET/MOSFET circuits using existing equations
    d. Differentiate the characteristics among MOSFET/JFET amplifier configurations
    e. Predict AC mid-band gains and impedances in JFET/MOSFET circuits using existing equations
    f. Measure bias levels, gains, and impedances of JFET/MOSFET amplifier circuits

10. BJT Characteristics/Basic Operation
    a. Explain the basic operation and operating regions of BJT
    b. Apply the BJT as a switch
    c. Apply equations for bias levels in BJT amplifier circuits
    d. Differentiate the attributes among the three BJT amplifier configurations
    e. Differentiate among amplifier classes (A, AB, B, C)
    f. Calculate AC mid-band gains and impedances in BJT circuits using existing equations

11. OP-AMP Characteristics
    a. Explain the basic characteristics of a differential transistor amplifier
    b. Explain the characteristics of an operational amplifier

12. OP-AMP Circuits
    a. Evaluate basic active filters
    b. Examine the trade-off between the closed-loop gain and bandwidth of op-amp amplifier circuits
    c. Verify the operation of basic OP-AMP circuits

13. Digital Electronics 1a
    a. Analyze Digital number systems
    b. Test functions of basic logic functions
    c. Implement Boolean expressions using combinational logic circuits
    d. Identify electrical signals or characteristics
    e. Test the operation of logic blocks

14. Digital Electronics 1b
    a. Test the operation of display devices
    b. Test the operation of sequential logic devices
    c. Determine functions of electronic memory
    d. Interface digital to field devices

15. Digital Electronics 2a
    a. Apply Boolean tools and other simplification techniques
    b. Differentiate specifications among logic families
    c. Build encoders, decoders, and multiplexers into a system
    d. Generate pulses and timing signals

16. Digital Electronics 2b
    a. Build clocked logic circuits to drive encoders, decoders and multiplexer systems with asynchronous and/or synchronous counters
    b. Implement a design using programmable logic devices
    c. Explain digital design considerations (relate to real world)
    d. Test an analog to digital interface

17. Microcontrollers/Microprocessors and Embedded Systems *(old #20)*
    a. Describe microcontroller/microprocessor architecture
    b. Program microcontrollers/microprocessors (target) using microprocessor language (preferably C)
    c. Apply Hexadecimal numbering system to memory mapped registers

d. Analyze General Purpose Digital I/O
e. Evaluate Parallel Communications
f. Analyze Analog to Digital Conversion
g. Analyze Interrupts
h. Implement Pulse Width Modulation (PWM)
i. Implement Serial Communications

Advanced Transfer Outcomes (18-23)

18. Power and Motor Systems 1 *(old #17)*
    a. Explain magnetic principles as related to electromechanical equipment
    b. Analyze single phase power transformers
    c. Apply formulas to balanced three-phase circuits including transformer applications
    d. Calculate component values for power factor correction

19. Power and Motor Systems 2 *(old #18)*
    a. Predict motor operation from motor properties and calculations
    b. Implement motor control circuits for start, stop and speed/torque for DC and/or AC motors
    c. Program a PLC or PAC or similar controller for motor control
    d. Describe other motor applications

20. PLC *(old #19)*
    a. Describe the architecture of a programmable logic controller (PLC)
    b. Utilize Boolean ladder logic to optimize circuits
    c. Associate I/O addresses to field devices
    d. Interface programming environment to PLC
    e. Apply instructions to PLC programs
    f. Design a PLC program using timers, counters, and comparison arithmetic to meet a system specification
    g. Develop Human-Machine Interfaces (HMI) for PLC systems
    h. Comply with established industry safety guidelines

21. DC & AC Electronics 3 *(old #24)*
    a. Analyze DC series-parallel circuits
    b. Express alternating current sinusoidal signals in the time domain and the phasor domain mathematically
    c. Explain reactance and impedance of an ideal resistor
    d. Explain DC and AC characteristics of an ideal inductor
    e. Explain DC and AC characteristics of an ideal capacitor
    f. Analyze an AC series electrical circuit using phasors
    g. Analyze an AC parallel electrical circuit using phasors

h. Analyze AC series-parallel circuits using phasors
i. Analyze multiple-source AC electrical circuits using superposition
j. Determine complex power in an AC circuit containing reactances
k. Analyze DC and AC circuits using nodal analysis technique
l. Determine the Thevenin equivalent circuit for a given DC or AC circuit
m. Determine the Norton equivalent circuit for a given DC or AC circuit
n. Determine load impedance for maximum power transfer between source and load
o. Analyze AC circuits that contain ideal transformers
p. Analyze balanced and unbalanced three-phase circuits
q. Demonstrate proper use of DC and AC electronic instrumentation in the laboratory
r. Create technical documentation

22. Electronic Circuit Analysis *(old #25)*
    a. Analyze first-order Resistor-Inductor (RL) and Resistor-Capacitor (RC) Alternating Current (AC) circuits.
    b. Develop the transfer function into Bode form for Resistor-Inductor (RL) and Resistor-Capacitor (RC) circuits
    c. Generate magnitude (in dB) and phase Bode Plots from a transfer function in Bode form
    d. Explain the Bode plot response of first-order low-pass and high-pass filters from the transfer functions
    e. Characterize the response of Resistor-Inductor-Capacitor (RLC) resonant circuits
    f. Determine Direct Current (DC) bias performance of linear transistor amplifier circuits
    g. Determine AC mid-band performance for BJT and FET linear transistor amplifier circuits
    h. Design first-order filters, resonant circuits, and linear transistor amplifiers in guided exercises from given specifications
    i. Execute measurement test plan of filters, resonant circuits, and linear transistor amplifiers

23. Data Communications and Networking *(old #27)*
    a. Describe Fundamental Communication and Networking Concepts
    b. Describe Serial Data Interface
    c. Describe Open Systems Interconnect (OSI) Model and TCP/IP Layers
    d. Analyze the Physical Layer
    e. Determine Line Coding and Modulation Waveforms
    f. Analyze A-to-D Conversion
    g. Describe Modems and Multiplexers
    h. Select Transmission Media for Various Applications
    i. Describe Data Link Layer Protocols
    j. Describe Local and Wide Area Networks
    k. Describe Network, Transport, and Higher Layer Devices, Protocols, and Services