Course Number and Title: ELM 230 Industrial Electronics

Campus Location:
Dover

Effective Date:
2018-51

Prerequisite:
ELM 130 or CEN 100

Co-Requisites:
none

Course Credits and Hours:
3.00 credits
2.00 lecture hours/week
3.00 lab hours/week

Course Description:
This course covers applications of industrial electronic components, including diodes, unijunction transistors (UJTs), silicone controlled rectifiers (SCRs), photoelectronics, sensors, transducers, operational amplifiers, and motor control circuits.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
None

Schedule Type:
Classroom Course

Disclaimer:
This workforce solution was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites, and including, but not limited to accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability or ownership.

Core Course Performance Objectives (CCPOs):

1. Identify diode schematic symbols, and describe their operating characteristics. (CCC 1, 2, 5; PGC 5)
2. Evaluate the characteristics and operating principles of special purpose diodes. (CCC 1, 2, 5, 6; PGC 2, 3, 4, 5)
3. Evaluate bipolar junction transistors and their operating characteristics by theoretical and practical means. (CCC 1, 2, 5, 6; PGC 2, 3, 4, 5)
4. Explain the theoretical and practical aspects of industrial sensors and thyristor circuits. (CCC 1, 2, 6; PGC 2, 3, 4, 5)
5. Explain the theoretical and practical aspects of operational amplifiers. (CCC 2, 6; PGC 2, 3, 4, 5)
6. Interface input/output devices to communicate between the microcontroller and its associated peripheral devices. (CCC 1, 2, 3, 6; PGC 2, 3, 4, 5)
7. Summarize how multivibrator circuits are used to produce free-running clock oscillator waveforms or to produce a timed digital level change triggered by an external source. (CCC 2, 6; PGC 2, 3, 4, 5)
8. Interpret basic digital concepts, number systems, and codes. (CCC 1, 2, 5, 6; PGC 1, 2)
9. Explain the principles of basic logic gates as used in digital circuitry. (CCC 1, 2, 5, 6; PGC 1, 2, 3, 4)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Identify diode schematic symbols, and describe their operating characteristics.
    1. Describe the electrical characteristics of a diode and the diode I-V curve.
    2. Describe the characteristics of a forward and reverse biased diode in terms of electrical approximations.
    3. Identify diode terminals on its schematic symbol and for various package styles.

    4. Interpret and use diode datasheets.
    5. Test a diode using a digital multimeter (DMM).
2. Evaluate the characteristics and operating principles of special purpose diodes.
    1. Identify a Zener diode schematic symbol, define its function, and describe its operating characteristics.
    2. Calculate the expected output of a Zener diode regulator, and determine the limits of Zener operation for the given circuit elements.
    3. Solve for the maximum and minimum values of current required to maintain regulation for a given Zener diode circuit.
    4. Predict the expected output waveform for a Zener limiting circuit with an alternating current input source.
    5. Identify a varactor diode schematic symbol, define its function, and describe its operating characteristics.
    6. Identify a light-emitting diode schematic symbol, define its function, and describe its operating characteristics.
    7. Identify a photodiode schematic symbol, define its function, and describe its operating characteristics.
    8. Identify an opto-isolator and solar cell, define their function, and describe their operating characteristics.
    9. Interpret and use data sheets for the above listed special purpose diodes.
3. Evaluate bipolar junction transistors and their operating characteristics by theoretical and practical means.
    1. Describe the basic structure and operation of bipolar junction transistors.
    2. Identify the terminals on a bipolar junction transistor schematic symbol and for various packages.
    3. Interpret and use bipolar junction transistor datasheets.
    4. Identify the voltages and currents that flow in a bipolar junction transistor.
    5. Test a bipolar junction transistor using a digital multimeter (DMM).
    6. Define *direct current* (DC*) beta* and *DC alpha*, and explain their significance.
    7. Sketch the DC load line for a bipolar junction transistor circuit.
    8. Define *saturation* and *cutoff*, and explain their significance.
    9. Describe how a bipolar junction transistor can be used as an amplifier or a switch.
4. Explain the theoretical and practical aspects of industrial sensors and thyristor circuits.
    1. Describe the characteristics and applications of the unijunction transistor (UJT), diode for alternating current (DIAC), silicone controlled rectifier (SCR), and triode alternating current switch (TRIAC) solid-state devices.
    2. Analyze and measure an industrial circuit using TRIAC, UJT, and SCR solid-state devices using acceptable industry standards and the tools and equipment required in the work environment.
    3. Describe the characteristics and applications for optical encoders, photo cells, proximity sensors, strain gauges, level sensors, pressure sensors, and temperature sensors.
5. Explain the theoretical and practical aspects of operational amplifiers.
    1. Describe the characteristics of an ideal operational amplifier (op-amp).
    2. Describe, analyze, test, and explain the significance of an op-amp's common-mode rejection ratio, slew rate, and voltage gain.
    3. Describe, analyze, and test the output signals for inverting and non-inverting linear op-amps and window op-amp comparators.
    4. Describe, analyze, and test the output signals for summing, differential, integrating, and differentiating linear op-amps.
    5. Analyze and explain the operation of special purpose op-amp circuits, including instrumentation, isolation, and Schmitt trigger configurations.
6. Interface input/output devices to communicate between the microcontroller and its associated peripheral devices.
    1. Explain input/output (I/O) and interrupt operations in a microcontroller.
    2. Compare and contrast different types of analog-to-digital (A/D) and digital–to-analog (D/A) converters.
    3. Interface I/O devices to the microcontroller.
    4. Write programs to perform I/O using handshaking and interrupts.
    5. Use a microprocessor or microcontroller to collect and process data signals from sensors and produce an output signal.
7. Summarize how multivibrator circuits are used to produce free-running clock oscillator waveforms or to produce a timed digital level change triggered by an external source.
    1. Describe the basic elements of a 555 timer.
    2. Describe how a 555 timer can be configured to operate as a one-shot circuit.
    3. Describe how a 555 timer can be configured to operate as an oscillator.
8. Interpret basic digital concepts, number systems, and codes.
    1. Differentiate between analog and digital signals.
    2. Discuss how voltage levels are used to represent digital quantities.
    3. Convert decimal form to and from binary form.
    4. Convert decimal form to and from hexadecimal form.
    5. Convert decimal numbers to binary coded decimal (BCD) form.
    6. Convert between the binary and octal number systems.
    7. Convert between the binary and hexadecimal number systems.
9. Explain the principles of basic logic gates as used in digital circuitry.
    1. Describe the operation and list truth tables for AND, OR, NAND, NOR, NOT, XOR, and XNOR logic gates.
    2. Identify digital devices that are used to implement logical functions.
    3. Construct timing diagrams showing the proper time relationships of inputs and outputs for various logic gates.
    4. Construct logic circuitry using the universal capability of NAND and NOR gates using acceptable industry standards and proper tools and equipment.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	–	100	=	A
83	–	91	=	B
75	–	82	=	C
0	–	74	=	F

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):

1. Under engineers' direction, design basic circuitry and draft sketches to clarify details of design documentation.
2. Build, modify, and test circuitry or electronic components according to engineering instructions, technical manuals, and knowledge of electrical or electronic systems.
3. Install, maintain, adjust, and calibrate electrical or electronic equipment.
4. Identify and resolve equipment malfunctions.
5. Read blueprints, wiring diagrams, schematic drawings, and engineering instructions for assembling, maintaining, or repairing equipment.
6. Employ ethical standards, sound leadership and management principles, and participate in lifelong learning.

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.