Mt. San Jacinto College
Integrated Course Outline of Record

Form B

Submitted by: James Bae **Date:** 11/12/2020

Department	Subject	Course Number	Title
Engineering: Technologies	Engineering: Technologies ENGR	122	Electronics for Engineering Technologists (formerly ENGR-522)

Units/Hours

Each lecture unit requires 1 hour per week of class time, and 2 hours per week of study outside of class.
Each laboratory unit requires 3 hours per week of class time.
Each activity unit requires 2 hours per week of class time and 1 hour per week of study outside of class.

Lecture Units	Lab Units	Total Units
2.00	1.00	3.00
Lecture Contact Hours	**Lab Contact Hours**	**Total Contact Hours**
32.00 - 36.00	48.00 - 54.00	80.00 - 90.00
Lecture Homework Hours	**Lab Homework Hours**	
64.00 - 72.00	0	

Stand Alone:

Program Applicable

AA/AS Degree General Ed Breadth Area(s):

-none-

General Education Justification:

Maximum Enrollment: 32

Maximum Enrollment Justification:

Course requires significant individualized instruction or assessment â€“ check all that apply:

* Course requires graded class discussion and graded class participation.
* Course requires 3 or more oral presentations by each student per semester.
* Course relies on small group dynamics as a means of instruction or assessment.

*** Course requires that each student be evaluated individually on a set of skills more than twice per semester.**

Justification: Computer programs are used. Specialized equipment is used. The course is heavily project and skill based. The course has group and individual projects that are presented orally in class, individual skill based demonstrations are performed and graded in class.

Grading Method: Letter Grade or P/NP

TOP code: 0934.00*

Can be Taken 1 **time(s) for credit** (max 4)

- Visual or Performing Arts course that is required to meet major requirements for UC/CSU
- Intercollegiate athletics course
- Academic/vocational competition course

Catalog Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course). (**75 words** or less in gray box below).

This course will cover the application of electronics in engineering technology. The topics studied include safety, Ohm's Law, engineering notation, direct current circuits, capacitance, inductance, reactance, impedance, analog and digital waveforms, basic motors, number systems, logic gates, Boolean algebra, flip-flops, shift registers, and microprocessors. Techniques in computer simulation and electrical measurements are emphasized.

Schedule Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course). (**25 words** or less in gray box below).

This course covers digital electronics topics such as current circuits, analog/digital waveforms, basic motors, flip-flops, microprocessors, and computer simulation techniques.

Need for the course:

This course provides the new to Engineering student with foundational skills to be immediately able to join an engineering company at an entry level or to pursue further opportunities in Engineering including more advanced job-skills training or pursuit of transfer pathways to a 4-year institution. It is one course of a series of courses required for a student to be awarded an Engineering Technologist Support Certificate. The Center of Excellence for Labor Market Research (California Community Colleges) estimates that entry-level Engineering Technology jobs (Civil, Electrical, Industrial, Mechanical, amongst other Technicians) will continue to grow in the Inland Empire/San Bernardino area from 2018-2023 by 3%, while offering positions earning above estimated â€œliving wageâ€ rates. This estimated 300 annual jobs outpaced the awards given at the time by local community colleges. This indicates a major opportunity for MSJC to continue to provide entry level Engineering job training, while growing the program to more advanced training to support professional training in the future. This course supports and is attached to the following program awards: ENGR - Engineering Technologist Support - Certificate, ENGR - Engineering: Drafting Technology - Certificate (Elective)

Prerequisite(s):

Prerequisites go through a separate approval process. See Forms E1-E6 for details.

(For further clarification, contact the Prerequisite Subcommittee)

- ENGR 121 with a Grade of C or better.

Corequisite(s):

Corequisites go through a separate approval process. See Forms E1-E6 for details.

-none-

Recommend Preparation:

Recommended Preparation goes through a separate approval process. See Forms E1-E6 for details.

-none-

Other Enrollment Criteria:

-none-

Learning Objectives:

(please number each objective and express in behavioral terms)

Upon the completion of the course the student will be able to do the following:

1. Set up NAND and NOR Gates to configure and test logic equivalencies of: NOT, AND, OR, Exculsive OR and Exclusive NOR logic functions.
2. Design, construct, and demonstrate a logic circuit which displays the students Birth Date using three toggle switches, various logic gates, and a single seven segment common anode LED display, using discrete TTL or CMOS Logic Gates.
3. Distinguish the causes and dangers of electrical shock and methods of prevention.
4. Describe the sequences in building and analyzing a simple circuit.
5. Analyze electrical circuits using Ohmâ€™s Law and Circuit Simulation Software.
6. Use appropriate equipment related to circuits such as using an oscilloscope to measure waveform time and connecting meters to a circuit and obtain accurate measurements.
7. Analyze electronic schematic symbols and determine use.
8. Design circuits to produce correct answers, demonstrating binary addition and subtraction.
9. Evaluate the use of shift registers in product design and the speed at which those products run.
10. Formulate flow charts to correctly apply simple programming concepts of microprocessors.

Course Content:

(please number the outline of main topics and subtopics)

1. Orientation and Safety
    1. Safety of Electricity, Electrical Shock, and Death
2. Fundamentals of Analog and Digital Electronics
    1. Foundational Elements
        1. Notation:
            1. Scientific Notation, Engineering notation, and SI notation
            2. Schematic symbols
        2. Components and Measurements:
            1. Resistors, Capacitors, Conductors, Insulators, Semiconductors
            2. Voltage, Current, Resistance, Impedance, Ohm’s Law
        3. Assembly of Circuits - including soldering
    2. Introduction to Analog- Waveforms and Characteristics
        1. Circuits and Outputs: AC/DC, RL, RC, and RLC
        2. Circuit Design Software
    3. Introduction to Digital – Waveforms and Characteristics
        1. Manufacturers datasheets – logic gate description, connection diagram, function table

2. Integrated Circuits (IC)- underlying circuitry, scale of integration, and packaging style.
3. Transistor-Transistor Logic (TTL) gates: sub-families, related to speed and power
4. Input and output values of combinational and sequential logic
5. Combinational logic designs implemented with logic gates - AOI designs
6. The flip-flop: fundamental building block of sequential logic

3. Combinational Logic
    1. Introduction to AOI Logic
        1. Binary number system and its relationship to the decimal number system in the combinational logic design process
        2. Translating a set of design specifications into a truth table
        3. Sum-of-products (SOP) & Products-of-sum (POS)
        4. Using AND, OR, & Inverter Gates
        5. Formal design process for translating a set of design specifications into a functional combinational logic circuit
    2. Introduction to NAND and NOR Logic
        1. Karnaugh Mapping - simplifying logic expressions and "don't care" conditions
        2. NAND adn NOR Gates
        3. Formal design process for translating a set of design specifications into a functional combinational logic circuit
    3. Date of Birth Design
        1. Description of Display - Seven-segment displays are used to display the digits 0-9 & some alpha characters
        2. Components and Logic Gates
        3. Design of functional combinational logic circuits
    4. Specific Comb Logic Circuits & Miscellaneous Topics
        1. Relationship between Number systems: Hexadecimal, octal, binary and decimal
        2. Binary Adder Circuits using XOR and XNOR gates, including half adders and full adders
        3. Multiplexer/de-multiplexer pairs used when a single connection is shared between multiple inputs and outputs
        4. Handling negative numbers in digital electronics
    5. Programmable Logic Devices
        1. Purpose and Description - To implement combinational logic circuits
        2. Require significantly less wiring than discrete logic, but they typically require a dedicated printed circuit board to hold the device
        3. Best suited for larger, more complex designs
        4. Circuit simulation software- enter and synthesize digital designs into programmable logic devices
4. Sequential Logic
    1. Transparent Latches & Flip-Flops: have capability to store data and can act as a memory device
    2. Flip-flops can be used to design single event detection circuits, data synchronizers, shift registers, and frequency dividers
    3. Asynchronous Counters (ripple counters) vs Synchronous Counters (parallel counters)
        1. Characteristics and behaviors of flip flops from external signal
        2. Implementation using integrated logic gates and various types of flip-flops
        3. Implementation of up counters, down counters, and modulus counters
    4. State-Machine Design
        1. Circuit design that sequences through a set of predetermined states controlled by a clock and other input signals - design variations
        2. Control common everyday devices such as elevator doors, traffic lights, and combinational (electronics) locks
        3. Implemention using small and medium scale integrated gates and programmable logic devices
5. Microcontrollers
    1. Flowcharting and programming: variable declaration, loops, and debugging

2. Programming languages (syntax) and variables (binary)
3. Microcontrollers – used in many everyday products
    1. Servo motor - delivers continuous motion at various speeds
    2. Programmed to sense and respond to outside stimuli
4. BOE-Bot Design Projects - real world demonstrations and purposes

Lab Content:

(please number the outline of main topics and subtopics)

1. Safety of Electricity and Proper use of equipment
2. Proper soldering skills and recognition of improperly soldered connections
3. Foundations and the Board Game Counter
4. Electrical quantities - Resistors, Ohm's Law
5. AC Waveforms -Signal, pulse, and function generators; Oscilloscope
6. Schematic symbols - Schematics, symbols
7. Electrical measurements for DC circuits - Series circuits, parallel circuits
8. RC and RL time constants; RC and RL reactance; RC and RL, RCL series impedance exercise
9. Digital Electronics - Number systems, Logic gates
10. Solid-state devices - Diodes, transistors, amplifiers, integrated analog circuits
11. Microcontrollers
12. BOE-Bot Design Projects

Methods of Instruction:

Methods of instruction may include, but are not limited to the following:

- **Method:** Lecture
  Integration: Multimedia presentation and computer simulations introducing safety, Ohm's Law, engineering notation, direct current circuits, capacitance, inductance, reactance, impedance, analog and digital waveforms, basic motors, number systems and related course topics/material.
- **Method:** Observation and Demonstration
  Integration: Observation and demonstration with supporting visual materials and computer programs, introducing topics such as logic gates, flip-flops, shift registers, and microprocessors.
- **Method:** Projects
  Integration: Analysis and description of the problem solving process and project development, with the final project presented to the class. Conducted individually and within a group.
- **Method:** Directed Study
  Integration: Group presentations of problem solving exercises will be made regarding topics such as the design and construction of a logic circuit.

Methods of Evaluation:

A student's grade shall be determined by the instructor using multiple measures of performance related to the course objectives. Methods of evaluation may include but are not limited to the following:

- **Method:** Class Participation
  Integration: Class Participation in topical discussions, problem solving activities and demonstrations (computational or non-computational), and simulated exercises. Participation and interaction in class will include engaging on component selection and design of electricity and electronic logic circuits, calculation of circuit outputs, use of circuit measurement equipment, and evaluation of circuit designs. Evaluation based on level of participation, reasoning processes, demonstrated skill set and accuracy of results.
- **Method:** Exams/Tests
  Integration: Quizzes will be periodic short objective tests of course related concepts. A mid-term and final examination will be given which show student understanding of terminology, knowledge of subject matter, and ability to evaluate why certain digital electronic processes are most effective given a specific situation or set of conditions. Test and quiz question format may include multiple choice, short answer/essay, and diagram

identification.
- **Method:** Group Projects
  Integration: Group oral presentations of problem solving exercises will be made regarding the problem solving process and project development for the Boe-Bot design projects. Group projects will be evaluated by level of team collaboration, accuracy, a clear demonstration of techniques used and ability of final design to perform the desired action.
- **Method:** Other
  Integration: Laboratory reports - In written format, students will describe and report on the activities performed during lab, demonstrating effective communication and documentation. This is evident by clarity, organization, thoroughness of content, with appropriate application of electrical design and safety, electronic logic and circuit calculations, as well as correct grammar and spelling.
- **Method:** Final Performance
  Integration: Lab Practical - Students will be required to identify and perform specific skills, assessed by level of accuracy of technique. Students will design electrical and electronic logic circuits, demonstrate proper use of measurement equipment, and employ appropriate electrical safety.
- **Method:** Projects
  Integration: Individual projects will be demonstrated and presented orally to the class and will be graded using skills assessment, mechanistic choice, organization and thoroughness. Students will demonstrate knowledge and application of electrical theory, logic circuit design, uses electrical measurement devices, and application of mathematical methods and equations for electrical/electronic design.
- **Method:** Oral Presentation
  Integration: Individual projects will demonstrated and presented orally to the class and will be graded on skill assessment, appropriate mechanistic choice, organization and thoroughness. Students will demonstrate knowledge and application of electrical theory, logic circuit design, uses electrical measurement devices, and application of mathematical methods and equations for electrical/electronic design.

Examples of Assignments:

Students will be expected to understand and critique college level texts or the equivalent. Reading and writing, as well as out of class assignments are required. These assignments may include but are not limited to the following:

1. Given a group of fifty assorted resistors, test each resistor and determine if good or bad by matching measured values with limits of tolerance. Separate the good and bad resistors and submit to the instructor for confirmation.
2. Given the analysis of a sample circuit, use a schematic diagram to "bread board" a circuit. Use both a digital multimeter and simulation program to verify parameters of the sample circuit. Submit the circuit board and schematic to the instructor for evaluation.
3. Design a circuit to control a seven segment display with a decimal to BCD (Binary Coded Decimal) decoder and a display driver. Simulate and verify the circuit operation. Obtain a printout of the circuit datasheet and submit to the instructor for evaluation.

Textbooks:

- Westcott, Sean, Jean Riescher Westcott (2017). *Basic Electronics: Theory and Practice 2nd Edition* Mercury Learning & Information. ISBN: 1683920333
- Scherz, Paul, Simon Monk (2016). *Practical Electronics for Inventors, Fourth Edition* McGraw Hill. ISBN: 1259587541

Other Resources:

Minimum Qualification

- Engineering (Masters Required) **or**
- Engineering Support **or**

- Engineering Technology (Masters Required)