ENGT M02: DIGITAL CIRCUITS

Originator

srelle

Co-Contributor(s)

Name(s)
Krad

College

Moorpark College

Attach Support Documentation (as needed)

Engr Adv Comm Meet_Agenda_2018.pdf
Recommendations of the committee.pdf
Attendees for Spring 2019 Advisory Committee.pdf
Engr Adv Comm Meet_Agenda_2019.pdf
Recommendations - Spring 2018.pdf
Attendees for 2018 Engineering Advisory Committee.pdf
ENGT M02_state approval letter_CCC000608541.pdf

Discipline (CB01A)

ENGT - Engineering Technology

Course Number (CB01B)

M02

Course Title (CB02)

Digital Circuits

Banner/Short Title

Digital Circuits

Credit Type

Credit

Honors

No

Start Term

Spring 2020

Catalog Course Description

Studies the construction and application of logic circuits as they relate to modern electronic computers and digital systems by applying Boolean algebra, mathematics, and number systems. Analyzes basic gate and digital circuits and their integration (MSI - medium scale integration and LSI - large scale integration) into complete systems. Describes and incorporates circuit simplifications, mapping, digital counters, registers, encoders/decoders, converters and timing.

Taxonomy of Programs (TOP) Code (CB03)

0934.00 - *Electronics and Electric Technology

Course Credit Status (CB04)

D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)

B (Transferable to CSU only)

Course Basic Skills Status (CB08)

N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)

C - Clearly Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
A - Primarily Developed Using Economic Development Funds

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Faculty notes on field trips; include possible destinations or other pertinent information
Naval Base in Point Mugu or in Port Hueneme; engineering firms in the area
(alternative assignments maybe substituted for the field trip)

Grading method
Letter Graded

Alternate grading methods
Credit by exam, license etc.

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
35
Maximum Contact/In-Class Lecture Hours
35

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
52.5
Maximum Contact/In-Class Laboratory Hours
52.5

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
87.5
Total Maximum Contact/In-Class Hours
87.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
70
Maximum Outside-of-Class Hours
70

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
157.5
Total Maximum Student Learning Hours
157.5

Minimum Units (CB07)
3
Maximum Units (CB06)
3

Advisories on Recommended Preparation
Knowledge of Elementary Algebra the equivalent of MATH M01 is recommended.

Entrance Skills

Entrance Skills
Students should be able to solve simple algebraic equations.

Requisite Justification

Requisite Type
Recommended Preparation

Requisite
MATH M01

Requisite Description

Course not in a sequence

Level of Scrutiny/Justification

Content review

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	apply digital design and logic concepts to analyze problems and synthesize solutions related to digital electronics in engineering.
2	demonstrate the operation of various electronic lab equipment to test the integrity of logic circuits designed for a particular application.
3	construct, analyze, and troubleshoot combinational and sequential digital circuits.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	demonstrate the operation of electronic lab equipment to test components and circuits by properly connecting and operating the following standard test equipment: power supplies, function generators, ammeters, voltmeters, ohmmeters, digital multimeters, and oscilloscopes.
2	explain the operation of digital logic gates.
3	identify the more commonly used integrated circuit families used in digital equipment and discuss their operation and characteristics.
4	use Boolean algebra to express logic operations and minimize logic circuits in design.
5	discuss the operation and application of counters, shift registers, and other combinational and sequential logic circuits.

Course Content

Lecture/Course Content

- **10% - Introduction to Digital Techniques**
  - Preview of Future Topics
  - Overview
- **10% - Semiconductor Devices for Digital Circuits**
  - Transistor Logic
  - Diode Logic
- **10% - Digital Logic Circuits**
  - And
  - Or (inclusive versus exclusive)
  - Not, Inversions
  - Derived Combinational Logic Forms
- **15% - Boolean Algebra and Testing**
  - Boolean Identities
  - DeMorgan's Theorem
  - Logic Synthesis
  - Simplification Methods
    - Veitch Diagrams
    - Karnaugh Maps
- **10% - Flip-Flops (F/F) and Registers**
  - SR F/F (Set input and Reset Output Flip/Flop)
  - Gated SR F/F
  - T F/F (Toggle Flip/Flop)
  - D F/F (Delay Flip/Flop)
  - Shift Registers (Transparent and None)
  - Serial-In/Parallel Out, and Vice Versa
  - Universal Asynchronous Receiver/Transmitter (UARTs)
- **10% - Sequential Logic Circuits**

    - State Machines
    - Sequence Variables and Conditions
- **15% - Combination Logic Circuits**
    - And/Nand
    - Or/Nor
    - And/Or/Invert Gates
    - Counters, Multiplexers, Demultiplexers, Encoders, Decoders
    - Programmable Array Logic Chips (PALs)
    - Field Programmable Gate Array (FPGAs)
- **10% - Semiconductor Memories**
    - Static Random Access Memories (SRAMS)
    - Dynamic Random Access Memories (DRAMS)
        - Row/Column Refreshing
        - Support Chips
    - Flash Memories
    - First In, First Out (FIFOs) and Last In, First Out (LIFOs)
- **10% - Data Conversion**
    - Analog to Digital Conversion (ADC)
    - Digital to Analog Conversion (DAC)

Laboratory or Activity Content

- **15% - Introduction to Laboratory Methods and Materials for Digital Techniques**
    - Overview of Equipment and Methods
    - Preview of Logic Analysis and Logic Probes
- **20% - Using Digital Logic Circuits**
    - And
    - Or (inclusive versus exclusive)
    - Not, Inversions
    - Derived Combinational Logic Forms
- **20% - Using Boolean Algebra and Testing**
    - Boolean Identities
    - DeMorgan's Theorem
    - Logic Synthesis
    - Simplification Methods
        - Veitch Diagrams
        - Karnaugh Maps
- **15% - Using Flip-Flops and Registers**
    - RS F/F
    - Gated RS F/F
    - T F/F
    - D F/F
    - Shift Registers (Transparent and Non)
    - Serial-In/Parallel Out, and Vice Versa
    - UARTs
- **15% - Using Sequential Logic Circuits**
    - State Machines
    - Sequence Variables and Conditions
- **15% - Using Combination Logic Circuits**
    - And/Nand
    - Or/Nor
    - And/Or/Invert Gates
    - Counters, Multiplexers, Demultiplexers, Encoders, Decoders
    - Programmable Array Logic Chips (PALs)
    - FPGAs

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):
Problem solving exercises

Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Group projects
Individual projects
Laboratory activities
Laboratory reports
Objective exams
Performances
Problem-solving exams
Quizzes
Skills demonstrations
Skill tests

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Computer-aided presentations
Collaborative group work
Class activities
Class discussions
Demonstrations
Field trips
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Instructor-guided use of technology
Laboratory activities
Lecture
Practica
Small group activities

Describe specific examples of the methods the instructor will use:

The instructor will use PowerPoint presentations, problem solving exercises, and demonstrations to explain the concepts of the course.

Representative Course Assignments

Writing Assignments

1. Answer questions from lectures, such as: Identify and describe the need for magnetometers in digital circuit applications.
2. Write short essays based on topics in digital technology, such as: Name and describe A/D and D/A converters, and compare the benefits and challenges of how they operate.

Critical Thinking Assignments

1. Design logical circuits based on a given scenario, such as: Design four different logical circuits in such a way that in each circuit the diode labeled LED1 will emit light for only one combination of both switches labeled A1 and B1. The switch combinations may not be the same in each circuit.
2. Design of combination logic circuits by student teams which have a concrete function that meets the goals of a given project such as: Design and create a block diagram for a 12-hour clock that counts in hours, minutes, and seconds as in 12:00, 12:01, 12:02, etc.

Reading Assignments

1. Read assigned chapters from the Digital Logic textbook to prepare for the lecture and accompanying lab experiments.
2. Read scientific and technical journal articles relevant to advances in Digital Logic and Digital Circuits to expand understanding of their usage in research and industry.

Skills Demonstrations

1. Illustrate the ability to construct and test a digital logic circuit in the lab using the materials given.
2. Illustrate the ability to troubleshoot a digital logic circuit that is malfunctioning using the appropriate testing tools.

Outside Assignments

Representative Outside Assignments

1. Write a technical report documenting the design and feasibility of a new digital technology that is used in the automotive industry.
2. Research on the Internet digital electronic devices, circuits and applications, as well as engineering techniques to solve problems, troubleshoot, and repair electronically nested system issues.

Articulation

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Los Angeles Pierce College	ELECTRN 72A and 72B	Digital Circuits IA and Digital Circuits Laboratory IB	3 and 1
San Diego City College	ELDT 123 and 123L	Introduction to Digital Circuits Lecture and Lab	3 and 1
Los Angeles Trade Technical College	ETNTLGY 159 and 160	Digital Circuits and Applications Lecture and Lab	3 and 1

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable

Yes

CSU Baccalaureate List effective term:

Spring 2020

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Classic Textbook
No

Description
Granburg, T. (2004). *Handbook for digital techniques for high-speed design: Design examples, signaling and memory techniques, fibre optics, modeling, and simulation to ensure signal integrity.* Prentice-Hall.

Resource Type
Textbook

Classic Textbook
No

Description
Zhang, H., Krooswyk, S., and Ou, J. (2017). *High-speed digital design: Design of high-speed interconnects and signaling.* Morgan Kaufmann.

Resource Type
Textbook

Classic Textbook
No

Description
Floyd, T. L. (2014). *Digital fundamentals*, (11th ed.). Pearson.

Resource Type
Textbook

Classic Textbook
No

Description
Mano, M.M., and Ciletti, M.D. (2017). *Digital design: with an introduction to the Verilog HDL, VHDL, and SystemVerilog, (*6th ed.). Pearson.

Resource Type
Software

Description
PSpice. Cadence, 9.1 ed.

PSpice is an acronym for Personal Simulation Program with Integrated Circuit Emphasis. This simulation program is for Microsoft Windows.http://www.cadencepcb.com/http://www.electronicslab.com/downloads/schematic/013/

Resource Type
Manual

Description
Cook, N.P., and Lancaster, G.A. (2004). *Laboratory manual to accompany electronics: A complete course,* (2nd ed.). Pearson.

Library Resources

Assignments requiring library resources
Writing, reading, critical thinking, outside assignments

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Research, using the Library's online resources, digital electronic devices, circuits and applications, as well as engineering techniques to solve problems, troubleshoot, and repair electronically-nested system issues.

Primary Minimum Qualification
ENGINEERING TECHNOLOGY

Review and Approval Dates

Department Chair
08/22/2019

Dean
08/26/2019

Technical Review
08/29/2019

Curriculum Committee
09/03/2019

DTRW-I
09/12/2019

Curriculum Committee
MM/DD/YYYY

Board
10/08/2019

CCCCO
10/12/2019

Control Number
CCC000608541

DOE/accreditation approval date
MM/DD/YYYY