PALOMAR COLLEGE
COURSE OUTLINE OF RECORD FOR
DEGREE CREDIT COURSE

X Transfer Course X A.A. Degree applicable course
(check all that apply)

COURSE NUMBER AND TITLE: ECHT 203 Digital/Computer Electronics

UNIT VALUE: 4.5

MINIMUM NUMBER OF SEMESTER HOURS: 96

BASIC SKILLS REQUIREMENTS: Appropriate language and computational skills.

ENTRANCE REQUIREMENTS

PREREQUISITE: None

COREQUISITE: None

RECOMMENDED PREPARATION: ECHT 100

SCOPE OF COURSE:

Fundamental logic functions of AND'ing, OR'ing, and inverting will be studied in various combinational and sequential logic circuits such as: encoders, decoders, multiplexers, demultiplexers, flip-flips, registers, counters, clocks, memories, and microprocessors. The architecture and programming of the digital microprocessor will be emphasized. The primary components required for proper operation of a PC (personal computer) will be addressed. Designing, testing, and troubleshooting of computers and special projects.

SPECIFIC COURSE OBJECTIVES:

Successful students will be able to:

1. Explain and apply four important tools related to description and analysis of digital logic circuits:
    a. Logic Diagrams
    b. Truth tables
    c. Timing diagrams
    d. Boolean algebra

2. Draw the logic symbols, write the output function equation, construct a truth table, and draw the timing diagram for the basic digital logic gates (AND, OR, NOT, NAND, and NOR).
3. Apply Boolean Laws, DeMorgan's Theorem, and Karnaugh maps to describe and simplify the characteristics.
4. Explain the meaning of the terms fan-out, fan-in, compatibility, dynamic and static logic, LSI, MSI, SSI, speed, Schottly, noise immunity, and interfacing.
5. Explain data sheet symbols, terminology, and parameters.
6. Prepare equations from a truth table.
7. Explain the operation and characteristics of encoders, decoders, decoder-drivers, multiplexers, demultiplexers, CMOS transmission gates, programmable logic arrays (PLA's), read-only memories (ROM's), 3-state devices, and bus systems.
8. Explain the meaning of Flip-Flops and Latches.
9. Analyze and draw the logic circuits for R-S, T, D, and J-K flip-flops.
10. Explain the terms master-slave, flip-flop, and edge triggering.
11. Explain the operation of the NAND latch, NOR latch.
12. Translate numbers from one radix (base) to another.
13. Prepare numbers in BCD (Binary Coded Decimal).
14. Define Parity.
15. Determine (read from table) the various ASCII (American Standard Code for Information Interchange) codes.
16. Prepare logic diagrams and explain the operation of the following counters:
    a. Binary ripple-up counter
    b. Binary ripple-down counter
    c. Binary ripple up/down counter
    d. Synchronous up-counter
    e. Synchronous down-counter
    f. Decimal counters
17. Describe shift-registers.
18. Perform mathematical operation using 1 and 2's complement notation.
19. Explain adder circuits.
20. Define logic diagrams and explain the operation of the following counters:
    a. RAM's
    b. ROM's
    c. PROM's
    d. EPROM's
    e. EEROM's
    f. EAROM's
21. Explain the operation of D/A (digital-to-analog) and A/D (analog-to-digital) converters.
22. Explain the difference between synchronous and asynchronous data communication systems.
23. Explain the difference between parallel and serial data communication systems.
24. Define terms: Microprocessor, microcomputer, input, output, I/O, I/O devices, I/O port, instruction, program, stored program concept, word, byte, MPU, CPU, ALU, operand, memory, address, read, write, RAM, fetch, execute, MPU cycle, mnemonic opcode, and bus.
25. Explain the purpose of the following circuits in a typical microprocessor: accumulator, program counter, instruction decoder, controller sequencer data register, and address register.
26. Using simplified block diagram of a hypothetical microprocessor identify the data flow that takes place between the various circuits during the execution of a simple program.
27. Describe the difference between inherent, immediate, direct extended, indexed, and relative addressing.

28. Prepare simple, straight-line (no branching) programs that can be executed by the ET-3400 Microprocessor Trainer.
29. Explain the difference between machine language, assembly language, interpretive language, and compiler language.
30. Define assembler, compiler, interpreter, object program, source program, BASIC, FORTRAN, PASCAL, and COBOL.
31. Prepare simple programs that use indexed and extended addressing.
32. Define 3-state logic and explain the need for it.
33. Identify the three busses common to all MPU's and explain the function of each.
34. Explain the difference between static and dynamic RAM's.

CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:

I. Number Systems and Codes
   A. Decimal Odometer
   B. Binary Decoder
   C. Number Codes
   D. Why Binary Numbers are used
   E. Binary-to-Decimal Conversion
   F. Microprocessors
   G. Decimal-to-Binary Conversion
   H. Hexadecimal Numbers
   I. Hexadecimal-Binary Conversion
   J. Hexadecimal-to-Decimal Conversion
   K. Decimal-to-Hexadecimal Conversion
   L. BCD Numbers
   M. The ASCII Code

II. Gates
   A. Inverters
   B. OR Gates
   C. AND Gates
   D. Boolean Algebra

III. More Logic Gates
   A. NOR Gates
   B. DeMorgan's First Theorem
   C. NAND Gates
   D. DeMorgan's Second Theorem
   E. EXCLUSIVE-OR Gates
   F. The Controlled Inverter
   G. EXCLUSIVE-NOR Gates

IV. TTL Circuits
   A. Digital Integrated Circuits
   B. 7400 Devices
   C. TTL Characteristics
   D. TTL Overview
   E. AND-OR-INVERTER Gates
   F. Open-collector
   G. Multiplexers

v. Boolean Algebra and Karnaugh Maps
   A. Boolean Relationships

B. Sum-of-Products Method
C. Algebraic Simplifications
D. Karnaugh Maps
E. Pairs, Quads, and Octets
F. Karnaugh Simplifications
G. Don't-Care Conditions

VI. Arithmetic-Logic Units
A. Binary Addition
B. Binary Subtraction
C. Half Adders
D. Full Adders
E. Binary Adders
F. Signed Binary Numbers
G. 2's Complements
H. 2's complement Adder-Subtractor

VII. Flip-Flops
A. RS Latches
B. Level Clocking
C. D Latches
D. Edge-Triggered D Flip-Flops
E. Edge-Triggered JK Flip-Flops
F. JK Master-Slave Flip-Flops

VIII. Registers and Counters
A. Buffer Registers
B. Shift Registers
C. Controlled Shift Registers
D. Ripple Counters
E. Synchronous Counters
F. Ring Counters
G. Other Counters
H. Three-State Registers
I. Bus-Organized Counters

IX. Memories
A. ROM's
B. PROM's and EPROM's
C. RAM's
D. A Small TTL Memory
E. Hexadecimal Addresses

X. Computer terminology
A. Software, Hardware, Firmware
B. Arithmetic/Logic Unit
    1. Architecture
        a. Binary, Hexadecimal, 2's Complemental Arithmetic
    2. Register Set
    3. Memory
        a. Memory Map
    4. Input/Output (I.O)
        a. Dedicated I/O and Memory Map
    5. Buses
        a. Data/Address/Control Bus

b. Dedicated Address/Data Bus
c. Multiplexed Address/Data Buses

XI. Microcomputer Program Languages
A. Machine Language (only language computer hardware understands, 1's and 0's (two voltage levels))
B. Assembly language (mnemonics (memory aids))
C. High-Level language (Basic/Fortran/Pascal/Cobol)

XII. Data Processing Forms
A. Instructions
B. Address
C. Numbers

XIII. Source and Object Programs

XIV. Assembler

XV. Interpreter and Compiler

XVI. "Fields" of an Assembly Language Instruction
A. Label Field
B. Operation Code (mnemonic) Field
C. Operand (address) Field
D. Comment Field

XVII. Pseudo-Operations
A. Assembler Directives
1. EQU (Equate)
2. NOP (No Operation)
3. FCB (Form Constant Byte)

XVIII. Types of Assemblers
A. Cross-Assemblers
B. Resident-Assemblers
C. Macro-Micro Assemblers
D. One/Two Pass Assemblers

XIX. Addressing Modes
A. Immediate
B. Immediate Extended
C. Page Zero
D. Modified Page Zero
E. Direct
F. Indexed
G. Relative
H. Extended
I. Inherent
J. Register
K. Bit

XXI. Designing Assembly Language Programs
A. Software Development Process
1. Flow Charts
2. Inline vs. Procedure Structured Program
3. Software Applications
a. Multiplication/Division
b. File Manipulation
c. Hardware Contorl
d. Data Manipulation

XXI. Primary Components of a PC (Personal Computer)
- A. System Board (motherboard)
- B. Interface Cards (daughterboard)
  1. FD/HD
  2. Video
  3. I/O
- C. Peripherals
  1. Monitor
  2. Keyboard

REQUIRED READING:

Tocci, Ronald J., and Neal S. Widmore. Digital Systems Principles and Applications. 8th ed. Upper Saddle River, NJ: Prentice Hall, 2001.

Handouts from the instructor describing the many interface circuits and programs.

SUGGESTED READING:

Staugaard, Jr., Andrew C. Microprocessor Interfacing. Benton Harbor, MI: Heath Company, 1982. Units 1 through 6.

Duntemann, Jeff. Assembly Language from Square One. Chicago, IL: Scott Foresman and Company, 1990. Chapters 1 through 9.

REQUIRED WRITING:

A formal laboratory report is required, reflecting industry standards for report writing and will be no less than five (5) pages in length. The discussions and conclusions of experimental results will require critical thinking.

OUTSIDE ASSIGNMENTS:

Students are expected to spend a minimum of three hours per unit per week in class and on outside assignments, prorated for short-term classes.

Reading assignments are from text, laboratory manuals, and handouts in preparation for class participation and quizzes/tests.

INSTRUCTIONAL METHODOLOGY:

Check all that apply:

_X_ lecture
_____ laboratory
_X_ lecture-laboratory combination

_____ directed study

DISTANCE LEARNING:

This course may be offered as a distance learning course and meets Title 5 regulations 55370, 55372, 55374, 55376, 55378, and 55380.
Yes ____ No X

If yes, check all that apply:

_____ Television Course (Video one-way, e.g. ITV, video cassette, etc.)
_____ Online Course (Text one-way, e.g. newspaper, correspondence, electronic file, etc.)
_____ Two-Way Video Conferencing (Two-way interactive video and audio)
_____ One-Way Video Conferencing (One-way interactive video and two-way interactive audio)
_____ Computer Assisted Instruction (A specialized form of mediated instruction relying primarily on student access to information and prepared lessons or teaching materials through a computer terminal, but not under immediate supervision of a qualified instructor.)

GRADING POLICY AND STANDARDS (include methods of determining whether the stated objectives have been met by students):

Quizzes/Tests	60%
Laboratory Reports	20%
Homework	20%

IS COURSE REPEATABLE FOR REASON(S) OTHER THAN DEFICIENT GRADE?
Section 1.01 Yes _____ No X Number of times course may be taken for credit: _____

If yes, identify specific provision of Title 5 Division 2 section(s), 55761-55763 and 58161 which qualifies course as repeatable:

CONTACT PERSON: George Hershman ext. 2563

SIGNATURES ON FILE