Electronics: Advanced Digital Systems (40S)

Instructor: Mr. Pulver
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Course Code: EXB40S
Credit: 1.0
Prerequisite: Digital Devices and Basic Logic (40S)
Suggested Grade Level: Grade 11,12
Delivery Format: Classroom instruction, advanced digital labs, simulations, and capstone project

Course Description

This course builds on basic digital logic by introducing students to sequential logic, programmable logic devices, microcontroller interfaces, and digital system design. Through labs and simulations, students will integrate complex subsystems, write simple HDL code, and develop functional digital systems using flip-flops, counters, shift registers, and more.

General Learning Outcomes (GLOs)

- Analyze and construct sequential logic circuits including flip-flops and counters.
- Design and test digital subsystems such as encoders, multiplexers, and decoders.
- Program and configure simple programmable logic devices (PLDs).
- Interpret timing diagrams and setup/hold requirements.
- Integrate microcontrollers with digital systems to perform specific control tasks.
- Apply simulation tools and debugging techniques to optimize designs.
- Demonstrate collaborative problem-solving and technical reporting skills.

Unit Breakdown

Unit 1: Review of Digital Logic Fundamentals

- Binary and hexadecimal systems
- Logic gate review
- Boolean simplification and truth tables

Unit 2: Advanced Combinational Circuits

- Adders and subtractors
- Multiplexers, demultiplexers
- Encoders, decoders, and comparators

Unit 3: Sequential Logic

- Flip-flops: SR, JK, D, T
- Synchronous and asynchronous counters
- Shift registers and ring counters

Unit 4: Programmable Logic Devices

- Types of PLDs: PAL, PLA, CPLD
- Introduction to VHDL/Verilog
- Programming simple logic with PLDs

Unit 5: Microcontroller Integration

- Basics of microcontrollers (Arduino/AVR)
- Digital I/O and interfacing
- Using sensors and actuators with logic

Unit 6: Digital System Design

- Subsystem integration
- Clock signals and synchronization
- Noise immunity and logic families

Unit 7: Emerging Technologies and Ethics

- FPGAs and ASICs
- Ethics in digital system design
- Environmental considerations

Unit 8: Capstone Project

- Design, build, and present a complete digital system (e.g., ALU, automation logic, display controller)

Assessment

- Labs and System Builds 40%
- Quizzes and Participation 20%
- Capstone Project and Presentation 40%

Resources

- Multisim Live or Logisim for simulation
- PLD trainers or software (e.g., Quartus Prime, Logisim-Evolution)
- Arduino Uno or equivalent microcontrollers
- Digital ICs (74HC, 4000 series), LEDs, 7-segment displays
- Online HDL tutorials and FPGA simulation tools