

Electronics, Programming and IoT

Course Outline:

Part 1: Electronics Circuits & Systems

1 Circuit Variable

- Electrical Engineering Overview
- Circuit Analysis: An overview
- Voltage and current
- The ideal basic circuit elements
- Power and energy

2 Circuit Elements

- Practical Perspective: Electrical safety
- Voltage and current sources
- Electrical resistance
- Construction of a Circuit model
- Kirchhoff's laws
- Analysis of a circuit containing a dependent source

3 Simple Resistive Circuits

- Resistors in Series
- Resistors in Parallel
- The Voltage-Divider and Current
- Voltage Division and Current Division
- Measuring Voltage and Current

4 Techniques of Circuit Analysis

- Introduction to the Node-Voltage Method
- The Node-Voltage Method and Dependent Sources
- Introduction to the Mesh-Current Method
- The Node-Voltage Method Versus the Mesh
- Source Transformations
- Thevenin and Norton Equivalent
- Maximum Power Transfer

5 The Operational Amplifier

- Operational Amplifier Terminals
- Terminal Voltages and Currents
- The Inverting-Amplifier Circuit
- The Summing-Amplifier Circuit
- The Noninverting-Amplifier Circuit
- The Difference-Amplifier Circuit

6 Inductance, Capacitance, and Mutual Inductance

- The Inductor
- The Capacitor
- Series-Parallel Combinations of Inductance and
- Mutual Inductance

7 Diode circuits

- Rectifier circuit
- Zener Diode circuits
- Clipper and Clamper circuits
- Multiple diode circuits
- Design Application: DC power supply

8 BJT amplifiers

- Basic Bipolar junction transistor
- Dc analysis of transistor circuits
- Basic transistor application
- BJT transistor Biasing
- Multistage circuits
- Design application: Diode Thermometer with a bipolar transistor

Part 2: C Programming

1 What Is C Programming, and Why Should I Care?

- What Is a Program?
- What You Need to Write C Programs
- The Programming Process
- Using C

2 Writing Your First C Program

- A Down-and-Dirty Chunk of Code
- The main() Function
- Kinds of Data

- Characters and C
- Numbers in C
- Wrapping Things Up with Another Example Program

3 What Does This Do? Clarifying Your Code with Comments

- Commenting on Your Code
- Specifying Comments
- Whitespace
- A Second Style for Your Comments

4 Your World Premiere—Putting Your Program's Results

- Up on the Screen
- How to Use printf()
- The Format of printf()
- Printing Strings
- Escape Sequences
- Conversion Characters
- Putting It All Together with a Code Example

5 Adding Variables to Your Programs

- Kinds of Variables
- Naming Variables
- Defining Variables
- Storing Data in Variables

6 Adding Words to Your Programs

- Understanding the String Terminator
- The Length of Strings
- Character Arrays: Lists of Characters
- Initializing Strings

7 Making Your Programs More Powerful with #include and #define

- Including Files
- Placing #include Directives
- Defining Constants
- Building a Header File and Program

8 Interacting with Users

- Looking at scanf()
- Prompting for scanf
- Problems with scanf()

9 Crunching the Numbers—Letting C Handle Math for You

- Basic Arithmetic
- Order of Operators
- Break the Rules with Parentheses
- Assignments Everywhere

10 Powering Up Your Variables with Assignments and Expressions

- Compound Assignment
- Watch That Order!
- Typcasting: Hollywood Could Take Lessons from C

11 The Fork in the Road—Testing Data to Pick a Path

- Testing Data
- Using if
- Otherwise...: Using else

12 Juggling Several Choices with Logical Operators

- Getting Logical
- Avoiding the Negative
- The Order of Logical Operators

13 A Bigger Bag of Tricks—Some More Operators for Your Programs

- Goodbye if...else; Hello, Conditional
- The Small-Change Operators: ++ and --
- Sizing Up the Situation

14 Code Repeat—Using Loops to Save Time and Effort

- while We Repeat
- Using while
- Using do...while

15 Looking for Another Way to Create Loops

- for Repeat's Sake!
- Working with for

16 Breaking in and out of Looped Code

- Take a break
- Let's continue Working

17 Making the case for the switch Statement

- Making the switch

- break and switch
- Efficiency Considerations

18 Increasing Your Program's Output (and Input)

- putchar() and getchar()
- The Newline Consideration
- A Little Faster: getch()

19 Getting More from Your Strings

- Character-Testing Functions
- Is the Case Correct?
- Case-Changing Functions
- String Functions

20 Advanced Math (for the Computer, Not You!)

- Practicing Your Math
- Doing More Conversions
- Getting into Trig and Other Really Hard Stuff
- Getting Random

21 Dealing with Arrays

- Reviewing Arrays
- Putting Values in Arrays

22 Searching Arrays

- Filling Arrays
- Finders, Keepers

23 Alphabetizing and Arranging Your Data

- Putting Your House in Order: Sorting
- Faster Searches

24 Solving the Mystery of Pointers

- Memory Addresses
- Defining Pointer Variables
- Using the Dereferencing *

25 Arrays and Pointers

- Array Names Are Pointers
- Getting Down in the List
- Characters and Pointers

- Be Careful with Lengths
- Arrays of Pointers

26 Maximizing Your Computer's Memory

- Thinking of the Heap
- But Why Do I Need the Heap?
- How Do I Allocate the Heap?
- If There's Not Enough Heap Memory
- Freeing Heap Memory
- Multiple Allocations

27 Setting Up Your Data with Structures

- Defining a Structure
- Putting Data in Structure Variables

28 Saving Sequential Files to Your Computer

- Disk Files
- Opening a File
- Using Sequential Files

29 Saving Random Files to Your Computer

- Opening Random Files
- Moving Around in a File

30 Organizing Your Programs with Functions

- Form Follows C Functions
- Local or Global

31 Passing Variables to Your Functions

- Passing Arguments
- Methods of Passing Arguments
- Passing by Value
- Passing by Address

32 Returning Data from Your Functions

- Returning Values
- The return Data Type
- One Last Step: Prototype

Part 3: Internet of Things (IoT)

1 The Internet of Things: An Overview

- The Flavour of the Internet of Things
- The “Internet” of “Things”
- The Technology of the Internet of Things
- Enchanted Objects
- Who is Making the Internet of Things?

2 Design Principles for Connected Devices

- Calm and Ambient Technology
- Magic as Metaphor
- Privacy
- Keeping Secrets
- Whose Data Is It Anyway?
- Web Thinking for Connected Devices
- Small Pieces, Loosely Joined
- First-Class Citizens On The Internet
- Graceful Degradation
- Affordances

3 Internet Principles

- Internet Communications: An Overview
- IP
- TCP
- The IP Protocol Suite (TCP/IP)
- UDP
- IP Addresses
- DNS
- Static IP Address Assignment
- Dynamic IP Address Assignment
- MAC Addresses
- TCP and UDP Ports
- An Example: HTTP Ports
- Other Common Ports
- Application Layer Protocols
- HTTP
- HTTPS: Encrypted HTTP

4 Prototyping Embedded Devices

- Electronics
- Sensors
- Actuators
- Scaling Up the Electronics
- Embedded Computing Basics
- Microcontrollers
- System-on-Chips
- Choosing Your Platform
- Arduino
- Developing on the Arduino
- Some Notes on the Hardware