Course Title: Hands-on Advanced IoT + Product Designing
Duration: 8 Weeks
Sessions: 3 per week × 3 hours each = 72 hours
Format: Project-based learning blending electronics with professional design and prototyping.

Week 1: Prototyping Foundations

Session 1: Intro to Rapid Prototyping

- Understanding the role of prototyping in IoT product design
- Exploring design thinking approaches for problem solving
- Different types of prototypes: functional vs. conceptual
- Common prototyping workflows used in hardware startups
- **Hands-on:** Explore real-world prototyping examples

Session 2: Enclosure Boxes & Cases Overview

- Importance of enclosures for IoT devices (safety, durability, usability)
- Types of enclosures (industrial, consumer, waterproof, modular)
- Standards for IoT casing (IP ratings, thermal management)
- Material considerations: plastics, composites, metals
- **Hands-on:** Examine breadboard-based enclosure samples

Session 3: Basic Wiring & Prototype Assembly

- Principles of safe circuit wiring and grounding
- Managing power supply and connections during prototyping
- Breadboard vs. PCB vs. soldered prototypes
- Common mistakes and safety concerns in assembly
- **Hands-on:** Assemble a simple IoT circuit with breadboard & sensors

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Week 2: 3D Design Essentials

Session 4: Intro to 3D Design Tools (Fusion360/TinkerCAD)

- Basics of CAD software environments
- Difference between parametric and free-form design
- Common 3D modeling tools for beginners and professionals
- Best practices in designing IoT components

- **Hands-on:** Create a simple 3D model (cube, case outline)

Session 5: Designing IoT Enclosures

- Steps for translating circuit dimensions into CAD models
- Planning for ventilation, mounting, and accessibility
- Examples of IoT enclosures: sensor hubs, controllers
- Industry practices in enclosure customization
- **Hands-on:** Model an IoT enclosure in Fusion360/TinkerCAD

Session 6: 3D Model Optimization

- Structural and thermal optimization for IoT cases
- Using CAD tools to reduce material waste
- Balancing aesthetics with function
- Common issues in 3D prints (overhangs, tolerances)
- **Hands-on:** Optimize an enclosure design for sensors & boards

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Week 3: 3D Printing Workflow

Session 7: Intro to 3D Printing

- Overview of 3D printing technologies (FDM, SLA, SLS)
- Understanding slicing software and print preparation
- Filament types and their applications (PLA, ABS, PETG)
- Key parameters: layer height, infill, supports
- **Hands-on:** Slice a 3D model for printing

Session 8: Hands-on 3D Printing

- Workflow from CAD model to physical print
- Printer calibration and maintenance basics
- Troubleshooting common 3D printing errors
- Quality testing for printed prototypes
- **Hands-on:** Print a small test object on Bambu Lab A1 Combo

Session 9: Post-processing Techniques

- Finishing methods for 3D prints: sanding, painting, acetone vapor
- Assembling multi-part enclosures
- Adding fasteners, clips, and joints
- Preparing 3D prints for user-facing products
- **Hands-on:** Post-process a printed case (sanding, fitting)

Week 4: PCB Design Basics

Session 10: PCB Fundamentals

- Role of PCBs in IoT product design
- Identifying PCB components and footprints
- Single-layer vs multi-layer PCBs
- Manufacturing considerations for IoT prototypes
- **Hands-on:** Explore real PCB samples and layouts

Session 11: IoT PCB Design (EasyEDA/KiCad)

- Basics of schematic design for IoT circuits
- Laying out PCB traces for sensors and microcontrollers
- Placement strategies for heat and EMI management
- Workflow for designing custom PCBs
- **Hands-on:** Create a simple IoT PCB design

Session 12: PCB Simulation & Validation

- Circuit simulation tools and their importance
- Running rule checks to ensure reliability
- Validating footprints for accurate assembly
- Case studies of PCB errors and fixes
- **Hands-on:** Simulate and validate a PCB design

Week 5: Enclosure + Sensor Integration

Session 13: Printing IoT Enclosures

- Special design considerations for IoT cases
- Adding ports, sensor windows, and cable slots
- Printing with durable materials for field use
- Testing fit for boards and batteries
- **Hands-on:** Print an enclosure for an IoT prototype

Session 14: Integrating Sensors into Cases

- Mechanical design for sensor mounting
- Vibration isolation, waterproofing, and durability
- Aligning sensor interfaces with external environment

- Strategies for modular enclosures
- **Hands-on:** Mount sensors inside a printed enclosure

Session 15: Assembly & Wiring with Cases

- Planning wiring paths inside enclosures
- Cable management & connector positioning
- Safety checks for power lines and short circuits
- Example: IoT soil moisture device with enclosure
- **Hands-on:** Assemble a full prototype inside its case

Week 6: Testing & Optimization

Session 16: Testing & Debugging Prototypes

- Step-by-step testing methodology
- Identifying integration issues (mechanical + electrical)
- Debugging tools for IoT hardware
- Importance of iterative testing in design cycles
- **Hands-on:** Debug a prototype system with sensors and case

Session 17: Power Optimization

- Power needs of IoT devices
- Role of buck converters and battery packs
- Strategies for extending battery life
- Case study: Power optimization in wearables
- **Hands-on:** Optimize prototype power consumption

Session 18: Enclosure Aesthetics & Branding

- Adding professional finishes to enclosures
- Branding techniques (logos, engravings, labeling)
- Design for market-ready appearance
- Importance of aesthetics in user adoption
- **Hands-on:** Add branding and finishing touches to prototype case

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Week 7: Iteration & Customization

Session 19: Rapid Iteration & Feedback

- Collecting feedback from early prototypes
- Design iteration cycles for hardware
- Agile methods in product design
- Examples of iterative improvements
- **Hands-on:** Redesign and improve an earlier enclosure

Session 20: Project-Specific Enclosure Design

- Independent project planning
- Customizing enclosures for chosen IoT projects
- Balancing function vs cost in design
- **Hands-on:** Create project-specific IoT enclosure in CAD

Session 21: 3D Printing Custom Projects

- Review of slicing settings for complex prints
- Printing and validating student-designed projects
- Troubleshooting large or detailed prints
- **Hands-on:** Print custom enclosure designed in Session 20

Week 8: Final Integration & Demo

Session 22: System Integration & Final Assembly

- Full product assembly workflow
- Combining enclosure, sensors, and PCBs
- Testing structural stability and usability
- Preparing prototypes for demo
- **Hands-on:** Assemble complete IoT prototype

Session 23: Prototype Testing & User Feedback

- Structured user testing methods
- Gathering usability data
- Refining prototypes based on real-world interaction
- **Hands-on:** Conduct live testing with prototype

Session 24: Final Demo Day

- Best practices for presenting hardware prototypes
- Peer feedback and evaluation techniques
- Professional documentation & presentation styles
- **Hands-on:** Showcase final IoT product design projects

Key Deliverables:

- **Design Files:** 3D models (STL) and PCB schematics/layouts.
- **Physical Prototypes:** 3D printed enclosures and assembled projects.
- **Final Project:** A market-ready IoT prototype in a custom enclosure.
- **Certificate of Completion** for successful students.

Tools & Platforms Required:

- **Hardware:** 3D Printer (Bambu Lab A1 Combo), assorted enclosure boxes, sensors, microcontrollers, soldering equipment.
- **Software:** Fusion360 / TinkerCAD, EasyEDA / KiCad, Bambu Studio / Cura.