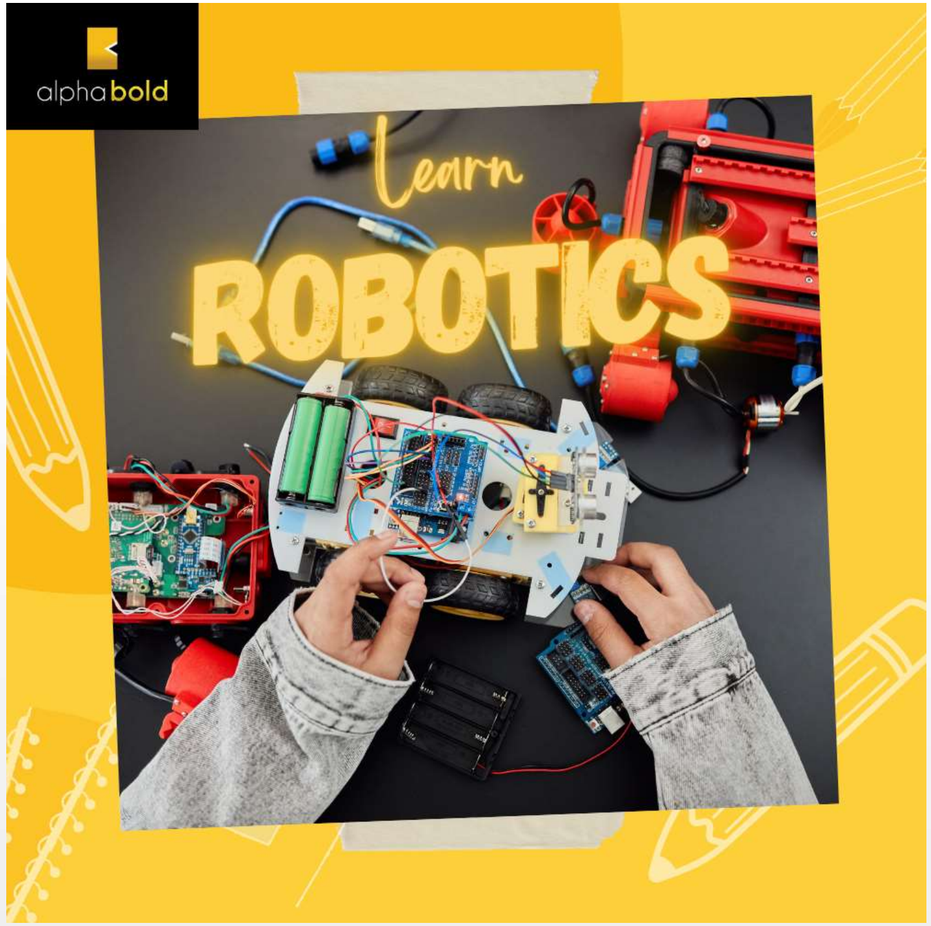
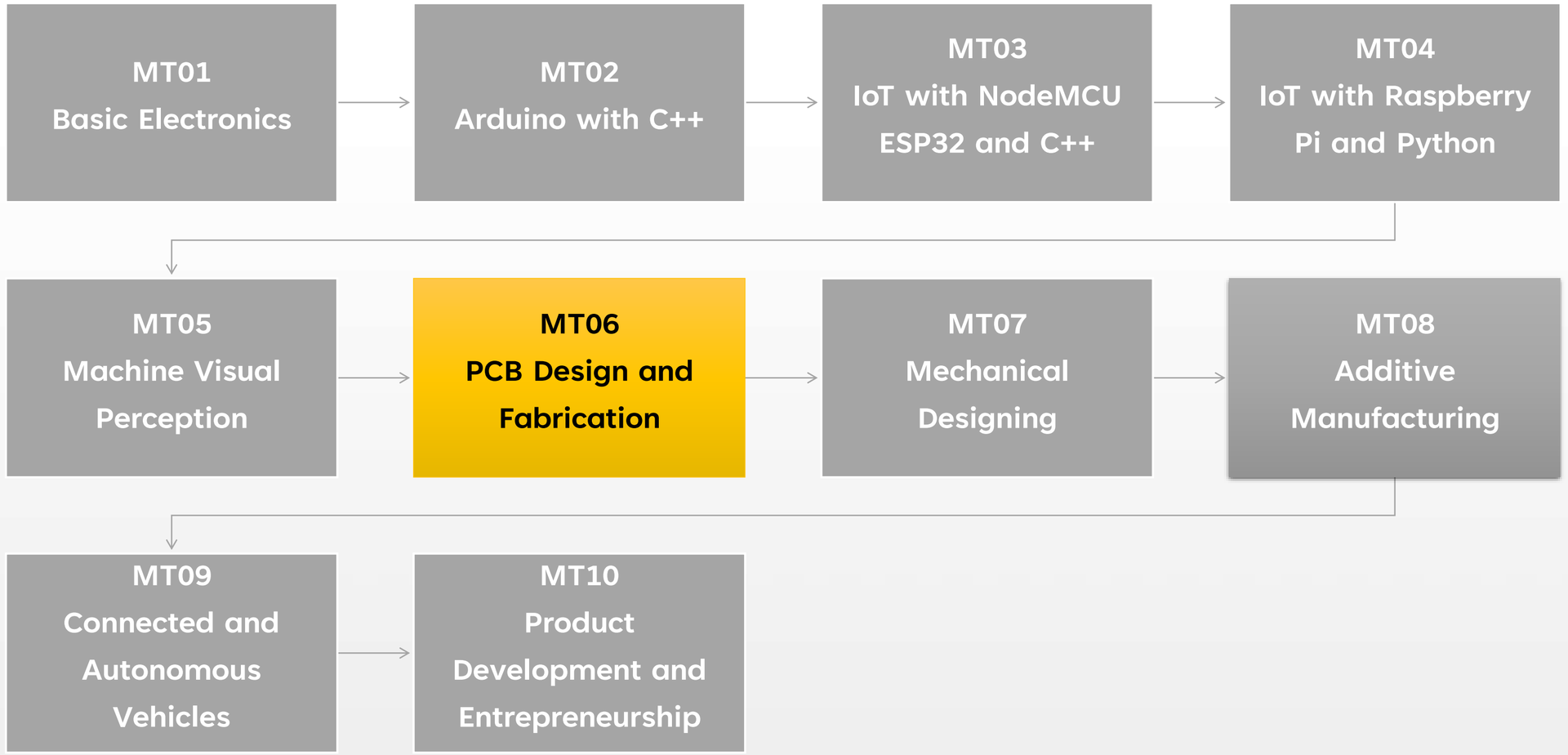
PCB Design and Fabrication

PCB Designing



Learning Pathway: Robotics

MT



alphabold

Course Unit Details

Overview

Welcome to the comprehensive course on PCB Designing and Fabrication. This course is designed to provide you with a solid understanding of the fundamental concepts and practical skills necessary for designing and fabricating printed circuit boards (PCBs). PCB designing is one of the core element in robotics to make the customized circuits of the robots. In this course we would like to learn PCB designing from scratch and practically making PCBs, which is desired in the field of robotics and automation.

We will begin with an introduction to PCB designing concepts, the distinction between PCBs and PWBs, various types of PCBs including single-sided and multi-layered, and an overview of PCB materials. Additionally, we will delve into Electronic Design Automation (EDA), market trends, and the indispensable role it plays in modern PCB design.

Throughout the course, you will gain hands-on experience with popular EDA tools such as EasyEDA and EagleCAD, as well as learn about SPICE and PSPICE environments. Furthermore, we will explore different types of electronic components and their packages, development tools for PCB design, PCB designing flowchart, PCB layers, essential keywords, and PCB materials. IPC standards and rules for tracks will also be discussed, along with practical sessions on auto-routing and PCB designing practice.

Lastly, you will be guided through the post-designing and PCB fabrication process, including printing, etching, drilling, soldering, and testing, culminating in a project where you will apply your knowledge to create and fabricate PCBs for academic and industrial purposes.

Aims

- Provide a comprehensive understanding of PCB design concepts and principles.
- Introduce Electronic Design Automation (EDA) tools and their applications in PCB design.
- Familiarize you with various types of electronic components and their package types.
- Equip you with the ability to design PCBs using industry-standard software.
- Develop essential skills for PCB fabrication processes.

Learning Outcomes

- **Master the fundamentals of PCB design and fabrication:** Gain a comprehensive understanding of the differences between PWB and PCB, explore various types based on layer count, and delve into fundamental design concepts like schematic representation, component layout, routing techniques, and fabrication considerations.
- **Become proficient in industry-standard tools:** Confidently navigate popular design software like EasyEDA, OrCAD, and PROTEUS to efficiently craft your PCB creations.
- **Design and fabricate real-world projects:** Translate your ideas into tangible electronic products by designing and fabricating functional PCBs for power supplies, sensor modules, embedded systems, and more.
- **Develop valuable industry skills:** Equip yourself with the knowledge and expertise to pursue careers in PCB design and fabrication, whether independently or within larger electronic design teams.
- **Adhere to industry standards:** Ensure the quality and manufacturability of your designs by understanding and applying IPC standards for schematic design, PCB layout, materials, and documentation.

Syllabus

- **1.Introduction to PCB designing concepts**
  - **1.1 Introduction and Brief History**
    - What is PCB?
    - Difference between PWB and PCB
    - Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer)
    - PCB Materials

- **1.2 Introduction to Electronic design Automation (EDA)**
  - Brief History of EDA
  - Latest Trends in Market
  - How it helps and Why it requires
  - Different EasyEDA tools
  - Introduction to SPICE and PSPICE Environment

Syllabus

- **2. Types of Components and Components Packages**
  - **2.1 Types of Components**
    - **2.1.1 Active Components**
      - Diode
      - Transistor
      - MOSFET
      - LED
      - SCR
      - Integrated Circuits (ICs)
    - **2.1.2 Passive Components**
      - Resistor
      - Capacitor
      - Inductor
      - Transformer
      - Speaker/Buzzer
- **2.2 Component Package Types**
  - **2.2.1 Through Hole Packages**
    - Axial lead
    - Radial Lead
    - Single Inline Package (SIP)
    - Dual Inline Package (DIP)
    - Transistor Outline (TO)
    - Pin Grid Array (PGA)
    - Metal Electrode Face (MELF)
    - Leadless Chip Carrier (LCC)
    - Small Outline Integrated Circuit (SOIC)
    - Quad Flat Pack (QPF) and Thin QFP (TQFP)
    - Ball Grid Array (BGA)
    - Plastic Leaded Chip Carrier (PLCC)

Syllabus

- 3. Introduction to Development Tools
  - 3.1 Introduction and Working of EagleCAD
  - 3.2 Introduction to PCB Design using EasyEDA tool
  - 3.3 Introduction to PCB Design using OrCAD tool
  - 3.4 Introduction to PCB Design using PROTEUS tool

- 4.PCB Designing Flow Chart
  - 4.1 Design Requirements and Specifications
  - 4.2 Schematic Capture
  - 4.3 Circuit Simulation (Optional)
  - 4.4 Netlist Generation
  - 4.5 Schematic and Netlist Review
  - 4.6 Component Library Development (if necessary)
  - 4.7 Design Rule Check (DRC)
  - 4.8 Design for Manufacturability (DFM):
  - 4.9 PCB Layout Design
  - 4.10 Design Verification
  - 4.11 Prototype Design (Optional)
  - 4.12 Prototype Fabrication (Optional)
  - 4.13 Prototype Testing (Optional)
  - 4.14 PCB Fabrication
  - 4.15 PCB Manufacturing
    - Printing
    - Etching
    - Drilling
  - 4.16 PCB Assembly
  - 4.17 Testing, Verification and Validation
  - 4.18 Design Review (Optional)
  - 4.19 Delivery

Syllabus

- **5.Description of PCB Layers**
  - **5.1 Electrical Layers**
    - Top Layer
    - Mid Layer
    - Bottom Layer
  - **5.2 Mechanical Layers**
    - Board Outlines and Cutouts
    - Drill Details
  - **5.3 Documentation Layers**
    - Components Outlines
    - Reference Designation
    - Text

- **6. Keywords and PCB Materials**
  - **6.1 Keywords and their Descriptions**
    - Footprint
    - Pad stacks
    - Vias
    - Tracks
    - Color of Layers
    - PCB Track Size Calculation Formula
  - **6.2 PCB Materials**
    - Standard FR-4 Epoxy Glass
    - Multifunctional FR-4
    - Tetra Functional FR-4
    - NelcoN400-6
    - GETEK
    - BT Epoxy Glass
    - Cyanate Aster
    - Polyimide Glass
    - Teflon

Syllabus

- **7 Rules for Track and IPC Standards**
  - **7.1 Rules for Track**
    - Track Length
    - Track Angle
    - Rack Joints
    - Track Size
  - **7.2 Study of IPC Standards**
    - IPC Standard For Schematic Design
    - IPC Standard For PCB Designing
    - IPC Standard For PCB Materials
    - IPC Standard For Documentation and PCB Fabrication
- **8. PCB Designing and Auto Routing**
  - **8.1 Starting the PCB designing**
    - Understanding the schematic Entry
    - Creating Library and Components
    - Drawing a Schematic
    - Flat Design / hierarchical Design
    - Setting up Environment for PCB
    - Design a Board
  - **8.2 Auto routing**
    - Introduction to Auto routing
    - Setting up Rules
    - Defining Constraints
    - Auto router Setup

Syllabus

- **9. PCB Designing Practice**
  - PCB Designing of Basic and Analog Electronic Circuits
  - PCB Designing of Power Supplies
  - PCB Designing of Different Sensor modules
  - PCB Designing of Electronics Projects
  - PCB Designing of Embedded Projects
- **10. Post Designing and PCB Fabrication Process**
  - Printing the Design
  - Etching
  - Drilling
  - Interconnecting and Packaging electronic Circuits (IPC) Standards
  - Gerber Generation
  - Soldering and De-soldering
  - Component Mounting
  - PCB and Hardware Testing

Syllabus

- **11. Project work**
  - Making the schematic of Academic and Industrial projects
  - Project Execution
    - Making the schematic
    - PCB Design
    - Soldering and De-soldering
    - Testing and Troubleshooting

- **Practical Activities**
  - 51 Tasks for PCB Design and Manufacturing

Course Unit Requirements

Prerequisite Course Unit

- MT05

CAD Software

- Eagle CAD
- EasyEDA tool
- OrCAD tool
- PROTEUS tool

Computing device with internet connectivity

Thank you for learning with alpha bold

alpha bold