Training Course on Advanced Printed Circuit Board (PCB) Design and Signal Integrity

Professional Development Training Course Outline

Category	Engineering	**Duration**	10 Days
Base Fee	$3,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Introduction

The Advanced PCB Design and Signal Integrity Training Course equips engineers and designers with the essential knowledge and hands-on skills required to design high-performance, reliable, and manufacturable printed circuit boards. In today's era of high-speed digital systems, PCB layout and signal integrity (SI) play a critical role in ensuring data integrity, electromagnetic compatibility (EMC), and overall system reliability. Training Course on Advanced Printed Circuit Board (PCB) Design and Signal Integrity provides in-depth insights into multi-layer PCB stackups, controlled impedance routing, power integrity, SI/PI simulation, and EMI/EMC considerations, enabling participants to design boards that meet both electrical and mechanical constraints.

With the rapid evolution of high-speed interfaces, RF design, automotive electronics, IoT, and 5G communication systems, designers must understand how to manage crosstalk, return paths, and signal reflections. This training integrates real-world case studies, simulation tools, and design-for-manufacturing (DFM) practices. Participants will gain expertise in industry-standard software such as Altium Designer, Cadence Allegro, and Mentor Graphics, making them fully prepared to deliver competitive and innovative hardware solutions.

Programme Curriculum

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Course Objectives

1. Understand the fundamentals of high-speed PCB design and layout.
2. Apply controlled impedance routing for signal integrity.
3. Design multi-layer stackups for performance and manufacturability.
4. Implement return path and via optimization strategies.
5. Perform pre-layout and post-layout signal integrity simulations.
6. Address power integrity using decoupling and plane analysis.
7. Mitigate EMI/EMC in high-speed digital designs.
8. Use EDA tools like Altium, Cadence, and Mentor for PCB design.
9. Apply differential pair routing for USB, HDMI, PCIe, etc.
10. Understand high-speed clock distribution and jitter reduction.
11. Optimize designs for manufacturability and thermal performance.
12. Validate board designs using real-world case simulations.
13. Manage constraints for DDR, Ethernet, and RF signals.

Organizational Benefits

1. Accelerate product development cycles with optimized PCB designs.
2. Improve reliability and compliance with signal integrity best practices.
3. Minimize costly rework and late-stage design changes.
4. Enable faster time-to-market through efficient DFM principles.
5. Enhance cross-functional collaboration between hardware and systems teams.
6. Reduce EMI/EMC test failures and certification issues.
7. Increase innovation capacity in high-speed product design.
8. Improve thermal management for high-power applications.
9. Gain competitive advantage through high-quality board performance.
10. Build internal expertise in cutting-edge EDA tools.

Target Participants

- PCB Layout Designers
- Hardware Design Engineers
- Signal Integrity Engineers

- Embedded System Developers
- RF and High-Speed Digital Designers
- Automotive and Aerospace Electronics Engineers
- IoT and Consumer Electronics Product Teams

Course Outline

Module 1: Introduction to Advanced PCB Design
- PCB design lifecycle and trends
- High-speed vs low-speed PCB overview
- Layers and materials
- Key metrics: SI, PI, EMI
- Case Study: Smartwatch PCB design

Module 2: PCB Stackup Design and Materials
- Core vs prepreg layers
- Dielectric constants and signal propagation
- Layer count optimization
- Stackup design for SI and EMC
- Case Study: 6-layer embedded system board

Module 3: Signal Integrity Fundamentals
- Signal degradation and reflections
- Transmission line theory
- Impedance mismatch and termination
- Reflection coefficient and eye diagrams
- Case Study: USB 3.0 design

Module 4: Controlled Impedance Routing
- Single-ended and differential routing
- Calculating and measuring impedance
- Via impedance and transitions
- Routing over splits and voids
- Case Study: HDMI signal routing

Module 5: Return Path and Grounding
- Return current loops
- Reference plane design
- Stitching capacitors and vias
- Ground bounce minimization
- Case Study: Mixed-signal PCB return path

Module 6: Crosstalk and Coupling Reduction
- Near-end and far-end crosstalk
- Trace separation guidelines
- Shielding and ground trace routing
- Mitigation using software tools
- Case Study: DDR4 memory routing

Module 7: Power Integrity and Decoupling
- Power distribution network (PDN) modeling

- Decoupling capacitor placement
- Plane resonance and loop impedance
- Power rail collapse prevention
- Case Study: FPGA board power optimization

Module 8: EMI/EMC Design Techniques
- Radiation sources and coupling paths
- Filtering and suppression strategies
- Shielding layout practices
- EMC compliance standards
- Case Study: Automotive ECU EMI testing

Module 9: Via Design and Optimization
- Types of vias (PTH, microvia, blind, buried)
- Current capacity and thermal effects
- Via-in-pad techniques
- Via stubs and back-drilling
- Case Study: High-speed telecom PCB

Module 10: Differential Pair Routing
- Length matching and skew control
- Pair separation and symmetry
- Stub and impedance control
- Clock and data line strategies
- Case Study: PCIe 4.0 layout

Module 11: Clock Distribution and Jitter Management
- Clock tree vs mesh topology
- Jitter sources and analysis
- Buffer selection and layout
- Reducing phase noise
- Case Study: High-speed ADC timing

Module 12: High-Speed Design Constraints
- Design rule creation in EDA tools
- Length matching, skew, and timing budgets
- Constraint-driven routing
- Signal integrity constraints
- Case Study: Ethernet PHY integration

Module 13: Design for Manufacturability (DFM)
- Pad/via sizing and tolerances
- Clearances and annular rings
- Panelization and soldermask design
- Assembly yield improvements
- Case Study: Mass production readiness

Module 14: PCB Thermal Management
- Power dissipation and hotspot identification
- Heat sink and copper pour usage
- Thermal via array design
- Simulation and thermal cameras

- Case Study: High-current DC/DC converter board

Module 15: Simulation and Validation
- SI and PI simulation workflows
- 3D field solvers and rule checks
- Post-layout verification
- EMI/EMC simulation
- Case Study: SI validation with S-parameters

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:
- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

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