Training Course on Mixed-Signal IC Design Techniques

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 Mixed-Signal IC Design Techniques Training Course provides an in-depth understanding of the design, simulation, and verification of integrated circuits that combine analog and digital functionalities. In today's data-driven world, mixed-signal ICs power everything from smartphones and IoT devices to medical electronics and automotive systems. Training Course on Mixed-Signal IC Design Techniques is designed to bridge the gap between analog and digital domains, focusing on ADC/DAC design, PLLs, data converters, clock management, and signal conditioning, essential for modern SoC (System-on-Chip) implementations.

Through a balanced mix of theory, practical labs, and real-world case studies, participants will explore key design flows using EDA tools such as Cadence Virtuoso, Spectre, and Verilog-A/M/S, covering layout considerations, verification challenges, and power-performance trade-offs. Engineers and designers will gain hands-on experience in noise analysis, mixed-signal simulation techniques, and layout parasitics, empowering them to develop robust and scalable mixed-signal ICs for emerging technologies such as AI hardware, 5G, automotive radar, and wearable devices.

Programme Curriculum

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Course Objectives

1. Understand fundamentals of analog and digital signal integration
2. Design and simulate high-performance ADC and DAC architectures
3. Implement clocking strategies using PLLs and clock dividers
4. Optimize mixed-signal layout for noise isolation and parasitics
5. Model circuits using Verilog-A, Verilog-AMS, and SystemVerilog
6. Explore analog front-end (AFE) design for sensor interfacing
7. Perform power and area optimization in SoC integration
8. Analyze jitter, phase noise, and timing errors in clock circuits
9. Use Cadence and Spectre tools for schematic to layout simulation
10. Apply mixed-signal verification methodologies (MSVM)
11. Implement low-power mixed-signal techniques for portable devices
12. Develop testbenches for mixed-signal simulation and corner analysis
13. Examine case studies from audio ICs, biomedical ICs, and RF transceivers

Organizational Benefits

1. Build internal IC design capabilities for analog/digital integration
2. Reduce time-to-market for mixed-signal SoC products
3. Improve IC performance, power efficiency, and reliability
4. Minimize design iterations with optimized simulation flows
5. Foster innovation in AI, biomedical, and sensor-based systems
6. Prepare teams for advanced EDA and verification environments
7. Enhance cross-functional collaboration in analog/digital co-design
8. Reduce dependency on third-party design and verification teams
9. Enable faster IP development for ASIC and custom IC projects
10. Increase competitiveness in automotive, IoT, and mobile IC markets

Target Participants

- Analog and Digital IC Designers
- Mixed-Signal SoC Engineers
- Electronics Design Engineers
- EDA Tool Users and Test Engineers
- Embedded Systems Developers

- Students and Researchers in Microelectronics
- System Architects and RF Designers

Course Outline

Module 1: Introduction to Mixed-Signal Design

- Differences between analog, digital, and mixed-signal domains
- Key applications in SoC and embedded systems
- Basic design flow and toolsets
- Challenges in mixed-signal integration
- Case Study: Mixed-signal IC in wearable fitness trackers

Module 2: Analog and Digital Fundamentals

- Analog signal processing basics
- Digital logic and timing principles
- Mixed-signal signal flow and integrity
- Common analog/digital interface techniques
- Case Study: Analog front-end for biosensors

Module 3: Data Converter Design (ADC/DAC)

- Nyquist-rate and oversampling ADCs
- DAC architectures: R-2R, current-steering
- Key performance metrics: INL, DNL, SNR
- Clock jitter and sampling errors
- Case Study: 12-bit SAR ADC in smart sensors

Module 4: Phase-Locked Loops and Clocking

- Basics of PLL, VCO, and divider circuits
- Phase noise and jitter analysis
- Clock distribution and skew mitigation
- Clock domain crossing (CDC) challenges
- Case Study: PLL in 5G baseband ICs

Module 5: Noise and Interference in Mixed-Signal Circuits

- Thermal, flicker, and quantization noise
- Crosstalk and substrate coupling
- Isolation techniques in layout and packaging
- Impact of noise on data converters
- Case Study: Audio codec IC in smartphones

Module 6: Power Management and Regulation

- LDOs and switching regulators for mixed-signal blocks
- Power gating and dynamic voltage scaling
- Ground bounce and supply integrity
- Low-noise design considerations
- Case Study: PMIC design for wearable SoCs

Module 7: Simulation Tools and Modeling

- Behavioral modeling with Verilog-A and AMS
- Spectre and ADE usage for AC, DC, and transient analysis
- Monte Carlo and corner simulations
- Mixed-signal simulation flow and testbenches
- Case Study: Verilog-A model for sensor interface

Module 8: Layout and Parasitic Extraction

- Floorplanning for analog-digital co-design
- Parasitic-aware layout and LVS/DRC checks
- Matching techniques and layout symmetry
- Guard rings and deep n-well implementation
- Case Study: Layout optimization of SAR ADC

Module 9: Mixed-Signal IP Integration

- IP reuse and integration in SoC environment
- Interface protocols: I2C, SPI, UART
- Static timing analysis and setup/hold violations
- Voltage domain crossing and isolation
- Case Study: AFE integration in bio-signal processor

Module 10: Low-Power Design Techniques

- Sleep modes and clock gating
- Energy-efficient ADC/DAC design
- Leakage minimization in analog blocks
- Battery-powered circuit design
- Case Study: Mixed-signal IC for hearing aids

Module 11: Mixed-Signal Verification Strategies

- Functional and behavioral verification
- Analog assertions and checkers
- AMS testbenches and waveform analysis
- Co-simulation with digital RTL
- Case Study: Mixed-signal verification of PLL loop

Module 12: Sensor Interface and Analog Front-End (AFE)

- Instrumentation amplifiers and filters
- Capacitive, resistive, and piezoelectric sensor interfacing
- Low-noise amplifier (LNA) design
- Calibration and linearization techniques
- Case Study: ECG analog front-end IC

Module 13: RF and High-Speed Mixed-Signal Interfaces

- RF front-end integration techniques
- Impedance matching and S-parameter analysis
- High-speed SerDes and transceivers
- Jitter tolerance and eye diagram analysis
- Case Study: RF transceiver in BLE chip

Module 14: Testability and DFT for Mixed-Signal Circuits

- Built-in self-test (BIST) techniques
- Loopback testing for ADC/DAC
- Parametric testing of analog blocks
- DFT strategies for analog-digital interfaces
- Case Study: BIST in automotive mixed-signal SoC

Module 15: Future Trends in Mixed-Signal IC Design

- AI-driven design automation tools
- 3D ICs and heterogeneous integration
- Neuromorphic mixed-signal circuits
- Design challenges in 6G and radar systems
- Case Study: Edge-AI mixed-signal IC in robotics

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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