Training Course on Design and Applications of GaN and SiC Power Devices

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 Design and Applications of Gallium Nitride (GaN) and Silicon Carbide (SiC) Power Devices training course is a cutting-edge program tailored for engineers and professionals working in power electronics, renewable energy systems, automotive electrification, and high-frequency converters. With the rise of wide bandgap (WBG) semiconductors, GaN and SiC devices have revolutionized power device design by enabling higher efficiency, smaller form factors, and improved thermal management compared to traditional silicon-based devices.

Training Course on Design and Applications of GaN and SiC Power Devices explores the core physics, fabrication techniques, switching characteristics, and system-level integration of GaN and SiC transistors. Participants will gain deep insights into high-efficiency converters, EV charging systems, RF applications, and high-voltage industrial drives. Using simulation tools, application notes, and real-world case studies, learners will design and evaluate power systems leveraging WBG devices for high voltage, high temperature, and fast switching environments.

Programme Curriculum

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Course Objectives

1. Understand the physics and materials science of GaN and SiC semiconductors
2. Compare performance metrics of WBG vs traditional silicon devices
3. Analyze switching characteristics and thermal behavior of GaN/SiC
4. Design high-frequency, high-efficiency power converters
5. Simulate GaN and SiC circuits using industry-standard tools (LTSpice, PLECS)
6. Implement gate driver circuits tailored for GaN and SiC FETs
7. Explore packaging technologies for thermal and EMI management
8. Design DC-DC and AC-DC converters using GaN and SiC
9. Evaluate reliability and failure modes of WBG devices
10. Integrate GaN/SiC devices in automotive powertrains and EV chargers
11. Apply WBG semiconductors in renewable energy and smart grids
12. Optimize layout and parasitic reduction for fast-switching designs
13. Analyze real-world applications: Lidar, RF amplifiers, and aerospace systems

Organizational Benefits

1. Accelerate innovation in high-performance power systems
2. Improve energy efficiency in electric vehicle platforms
3. Reduce converter size and system cooling requirements
4. Enhance product lifetime with reliable WBG devices
5. Equip teams with simulation-based design capabilities
6. Facilitate faster go-to-market with efficient power modules
7. Enable compliance with global energy efficiency standards
8. Future-proof hardware designs for AI, 5G, and EV infrastructure
9. Promote cross-domain expertise in digital control and power hardware
10. Strengthen organizational leadership in power semiconductor technology

Target Participants

- Power Electronics Engineers
- Electrical Design Engineers
- Hardware System Architects
- Automotive Powertrain Developers
- Renewable Energy System Integrators

- Researchers and Faculty in Electronics Engineering
- Graduate Students in Semiconductor Devices and Power Systems

Course Outline

Module 1: Introduction to Wide Bandgap Semiconductors

- Overview of WBG materials: GaN vs SiC vs Silicon
- Benefits of wide bandgap devices in modern systems
- Device-level characteristics and bandgap theory
- Thermal conductivity and breakdown voltage
- **Case Study**: GaN adoption in 5G base stations

Module 2: GaN Device Fundamentals

- Lateral vs vertical GaN FET structures
- Enhancement-mode vs depletion-mode GaN
- Switching speed and dead-time minimization
- Voltage ratings and dynamic performance
- **Case Study**: GaN in high-speed USB chargers

Module 3: SiC Device Fundamentals

- SiC MOSFETs and diodes operation
- High-voltage and high-temperature characteristics
- On-state resistance and switching loss analysis
- Packaging options for SiC devices
- **Case Study**: SiC in industrial motor drives

Module 4: Thermal Management in WBG Devices

- Junction-to-case and system-level thermal modeling
- Heatsinks, TIMs, and active cooling strategies
- Thermal impedance and transient analysis
- GaN/SiC package thermal limits
- **Case Study**: Thermal design of EV inverters

Module 5: Gate Driver Design for GaN and SiC

- Gate voltage requirements and isolation techniques
- Common-mode transients (dV/dt) handling
- Driver ICs and integrated solutions
- Bootstrap and negative drive schemes
- **Case Study**: Gate driver for 650V GaN FETs

Module 6: EMI and Parasitic Management

- Parasitic inductance and capacitance effects
- PCB layout guidelines for WBG designs
- Snubber and filtering techniques
- Radiated vs conducted emissions
- **Case Study**: EMI issues in GaN-based telecom PSU

Module 7: DC-DC Converter Design with GaN/SiC

- Topologies: Buck, Boost, LLC, Flyback
- Frequency and efficiency optimization
- Voltage stress and ZVS techniques
- Digital control integration
- **Case Study**: Compact 48V-to-12V GaN converter

Module 8: AC-DC Conversion and PFC

- Bridgeless and totem-pole PFC design
- GaN/SiC for universal AC input systems
- Harmonic mitigation and power quality
- Thermal performance in rectifiers
- **Case Study**: GaN-based server power supply

Module 9: Simulation and Modeling

- Behavioral and SPICE modeling of GaN/SiC
- PLECS and LTspice for fast prototyping
- Extracting switching waveforms and efficiency
- Integration into MATLAB/Simulink
- **Case Study**: SiC converter simulated in PLECS

Module 10: High Power and High Voltage Applications

- Inverter design for PV and battery storage
- High-voltage SiC switches in HVDC systems
- Dual-active-bridge topologies
- Isolation and creepage considerations
- **Case Study**: 1.2kV SiC in solar inverters

Module 11: Reliability and Ruggedness

- Short-circuit robustness and avalanche ratings
- Gate oxide reliability and stress conditions
- Lifetime prediction methodologies
- Failure analysis techniques
- **Case Study**: Accelerated life testing of GaN transistors

Module 12: Applications in Automotive Systems

- SiC in traction inverters for EVs
- On-board chargers using GaN and SiC
- Vehicle-to-grid (V2G) and fast charging
- Safety and ISO26262 considerations
- **Case Study**: Tesla’s adoption of SiC in Model 3

Module 13: Renewable and Smart Grid Integration

- GaN/SiC for microinverters and grid-tie inverters
- Islanding detection and reactive power control
- Wide input voltage handling
- Grid code compliance
- **Case Study**: GaN inverter for home solar

Module 14: RF and Wireless Charging Applications

- RF GaN for power amplifiers
- High-frequency resonant converters
- Inductive charging with WBG devices
- Compactness and efficiency trade-offs
- **Case Study**: GaN-based 200W wireless charger

Module 15: Trends and Future of GaN and SiC

- Market projections and technology roadmaps
- GaN-on-Si vs GaN-on-GaN developments
- 3.3kV SiC MOSFETs and beyond
- Integrated GaN ICs (GaNFast, GaNPower)
- **Case Study**: Future of WBG in aerospace power systems

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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