Training Course on Optoelectronics and Photonic Integrated Circuits

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 rise of ultra-high-speed communications, precision sensing, and next-generation computing has driven an unprecedented demand for innovations in optoelectronics and photonic integrated circuits (PICs). Training Course on Optoelectronics and Photonic Integrated Circuits equips participants with cutting-edge knowledge in the design, fabrication, and application of PICs and optoelectronic devices, including lasers, photodetectors, modulators, and waveguides. With increasing adoption in industries such as 5G/6G communications, quantum computing, LiDAR, and biophotonics, this course is a vital asset for engineers and researchers seeking to future-proof their skills.

Through hands-on case studies, simulations, and in-depth discussions, participants will master photonic chip design, packaging, testing, and integration. The course combines theoretical insights with real-world applications such as silicon photonics, fiber-optic networks, and advanced semiconductor photonic technologies. With a strong emphasis on nanophotonics, AI-assisted photonic design, and green photonics, this course fosters both academic and industrial excellence in a rapidly evolving field.

Programme Curriculum

Training Course on Optoelectronics and Photonic Integrated Circuits

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Course Objectives

1. Understand the fundamentals of optoelectronic devices and photonic integrated circuits.
2. Apply silicon photonics principles in real-world PIC design.
3. Analyze high-speed optical communication systems and their components.
4. Simulate and fabricate waveguides, modulators, and lasers using modern tools.
5. Explore quantum photonics and its practical applications.
6. Investigate LiDAR technology and its role in autonomous systems.
7. Design energy-efficient green photonic circuits for sustainability.
8. Integrate AI/ML in photonics for optimization and fault detection.
9. Examine photonic biosensors for healthcare and diagnostics.
10. Understand photon-electron interaction in next-gen optical computing.
11. Master photonics packaging and testing procedures.
12. Apply photonic ICs in 5G/6G systems for ultra-fast data transfer.
13. Conduct case-based simulations using photonic design software.

Organizational Benefits

1. Build in-house expertise in high-speed photonics.
2. Accelerate R&D innovation in optoelectronic systems.
3. Gain a competitive edge with future-ready technologies.
4. Reduce outsourcing by upskilling internal engineers.
5. Improve product design using simulation-based training.
6. Ensure compliance with emerging photonics standards.
7. Enhance efficiency in telecom and datacom applications.
8. Access case studies applicable to your industry vertical.
9. Foster collaboration between electrical and optical teams.
10. Prepare for transitioning to quantum and AI-powered photonics.

Target Participants

- Optical and Electronics Engineers
- Research Scientists in Photonics
- Semiconductor and IC Designers
- Telecom and Datacom Professionals

- Graduate Students in Electrical, Optical, or Quantum Fields
- Product Developers in Imaging, Sensor, or LiDAR Technologies
- Academic Researchers and Faculty in Photonics

Course Outline

Module 1: Fundamentals of Optoelectronics

1. Photons vs. Electrons – Basic Interactions
2. Emission and Absorption Processes
3. Light Sources: LEDs and Lasers
4. Photodetectors: PIN, APD, and SPAD
5. Materials for Optoelectronic Devices

Module 2: Photonic Integrated Circuit Basics

1. PIC Architecture and Components
2. Passive vs Active Photonic Elements
3. Silicon-on-Insulator (SOI) Technology
4. Optical Coupling and Losses
5. Introduction to Foundry Design Kits

Module 3: Optical Waveguides

1. Step-Index and Graded-Index Waveguides
2. Fabrication Techniques and Tolerances
3. Bending Losses and Dispersion
4. Single-mode vs Multimode Design
5. Case Study: Waveguide Design in AWGs

Module 4: Optical Modulators and Switches

1. Electro-Optic Effect and Mach-Zehnder Interferometers
2. Thermo-Optic Modulators
3. Electro-Absorption Modulation
4. Digital vs Analog Modulation in PICs
5. Case Study: High-Speed Optical Switching

Module 5: Photodetectors and Optical Receivers

1. Photodetector Physics
2. Avalanche Photodiodes (APDs)
3. Responsivity and Noise Analysis
4. High-Speed Receiver Design
5. Case Study: Optical Sensing in Biomedical Devices

Module 6: Laser Integration and Tuning

1. DFB and DBR Laser Structures
2. Wavelength Tuning Techniques
3. External Cavity Lasers
4. Hybrid and Monolithic Integration
5. Case Study: Tunable Lasers for Telecom

Module 7: Simulation and Modeling Tools

1. Lumerical and COMSOL Photonics Suite
2. FDTD and BPM Methods
3. Photonic Design Automation (PDA) Tools
4. Tuning Parameters for Yield Optimization
5. Simulation Case: Splitter Optimization

Module 8: Advanced Fabrication Techniques

1. Photolithography and Etching
2. Cleanroom Protocols
3. Integration of Electronics and Photonics
4. Packaging and Bonding Challenges
5. Case Study: InP vs Silicon PICs

Module 9: PIC Testing and Characterization

1. Optical Power and Spectral Measurements
2. Eye Diagrams and Bit Error Rate
3. Wafer-Level Testing Methods
4. Environmental and Stress Testing
5. Case Study: Reliability Testing in Aerospace

Module 10: PICs in Data Centers and 5G

1. Optical Interconnects in Data Centers
2. Co-Packaged Optics (CPO)
3. PIC Applications in 5G Base Stations
4. WDM and PAM-4 in Photonics
5. Case Study: Photonic Deployment at Facebook/Meta

Module 11: LiDAR and Photonics in Mobility

1. Types of LiDAR Systems
2. FMCW vs Pulsed LiDAR
3. PIC-Based LiDAR Design
4. Automotive Integration Challenges
5. Case Study: Waymo LiDAR Technologies

Module 12: Biophotonics and Medical Applications

1. Optical Biosensors and Diagnostics
2. Spectroscopy in Biophotonics
3. PICs in Neural Interfaces
4. On-chip Lab Technologies
5. Case Study: Photonic Chips in COVID-19 Testing

Module 13: Quantum Photonics and Computing

1. Quantum Dot Emitters and Single-Photon Sources
2. Integrated Quantum Circuits
3. Entanglement on a Chip
4. Quantum Key Distribution Systems

5. Case Study: Xanadu and PsiQuantum Architectures

Module 14: AI and Machine Learning in Photonics

1. AI-Optimized Photonic Circuit Design
2. Neural Networks for Signal Recovery
3. Defect Detection via ML
4. Reinforcement Learning in Tuning PICs
5. Case Study: AI-Driven Layout Automation

Module 15: Green Photonics and Sustainability

1. Energy-Efficient Optical Networks
2. Eco-Friendly Materials and Fabrication
3. Thermal Management in PICs
4. Lifecycle Assessment in Photonics
5. Case Study: Green Photonic Startups

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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