Advanced Biosensors and Biodevices Training Course

Professional Development Training Course Outline

Category	Biotechnology and Pharmaceutical Development	**Duration**	10 Days
Base Fee	$4,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The field of Advanced Biosensors and Biodevices is currently undergoing a revolutionary phase, positioned at the critical intersection of biomedical engineering, nanotechnology, and AI/Machine Learning. These cutting-edge analytical tools are indispensable for driving the next generation of diagnostics, real-time health monitoring, and environmental analysis. This course provides an intensive, comprehensive exploration of the fundamental principles, advanced fabrication techniques, and diverse transduction mechanisms including electrochemical, optical, and mass-based sensors that define modern biosensing. Participants will master the complexities of designing high-sensitivity, selective devices and integrating them into robust platforms, preparing them to innovate in an era where data-driven, point-of-care (PoC) diagnostics are paramount.

Advanced Biosensors and Biodevices Training Course is specifically engineered to bridge the knowledge gap between theoretical concepts and practical application in industry. It places a strong emphasis on interdisciplinary skills, covering everything from the selection of appropriate biorecognition elements and nanomaterial-enhanced performance to the critical considerations of regulatory compliance and commercialization pathways. By analyzing numerous real-world case studies such as continuous glucose monitoring and liquid biopsy for cancer attendees will gain the strategic and technical expertise required to develop and deploy wearable biodevices, Lab-on-a-Chip (LoC) systems, and IoT-integrated healthcare solutions, directly contributing to the future of personalized medicine and global health security.

Programme Curriculum

Advanced Biosensors and Biodevices Training Course

Introduction

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Course Duration

10 days

Course Objectives

1. Master fundamental biosensor design principles and diverse transduction mechanisms
2. Evaluate the role of nanomaterials in enhancing sensor performance and sensitivity.
3. Design and characterize high-performance electrochemical biosensors for biomarker detection and diagnostics.
4. Implement Surface Plasmon Resonance (SPR) and other label-free optical biosensing techniques for real-time molecular interaction analysis.
5. Develop and integrate microfluidic systems and Lab-on-a-Chip (LoC) devices for complex sample processing and multiplexed assays.
6. Apply Machine Learning (ML) and AI algorithms for sophisticated biosensor data processing, predictive modeling, and signal interpretation.
7. Fabricate and prototype wearable biodevices and implantable sensors for continuous, remote patient monitoring (RPM).
8. Analyze the technology and applications of Point-of-Care (PoC) diagnostics for rapid, decentralized clinical decision-making.
9. Explore advanced biorecognition using aptamers, phage display, and CRISPR-based diagnostics
10. Assess the application of biosensors in liquid biopsy for non-invasive detection of circulating tumor DNA (ctDNA) and other analytes.
11. Understand the regulatory requirements and commercialization pathways for new biodevices.
12. Integrate biosensors with Internet of Things (IoT) platforms for large-scale data collection and secure cloud-based analytics.
13. Design practical biosensing solutions for critical areas like environmental monitoring, food safety, and pathogen detection.

Organizational Benefit

- Accelerated R&D and Product Development.
- Competitive Advantage in Diagnostics.
- Enhanced Interdisciplinary Collaboration.
- Improved Quality and Regulatory Compliance.
- Future-Proofing Workforce Skills.

Target Audience

1. Biomedical Engineers and Bioengineers.
2. R&D Scientists and Researchers companies.
3. Electrical and Mechanical Engineers.
4. Chemists and Biologists.
5. Data Scientists and AI/ML Engineers.
6. Clinical Researchers and Pathologists.
7. Product Managers and Technical Consultants o.
8. Advanced Graduate Students.

Course Modules

Module 1: Foundations of Advanced Biosensors

- Principles of Biorecognition and Transduction Mechanisms.
- Key Performance Metrics.
- Biological Recognition Elements.
- Interfacing biology with electronics.
- Noise sources, non-specific binding, and signal-to-noise ratio optimization.
- Case Study: Evolution of the Glucose Biosensor

Module 2: Electrochemical Biosensors (ECB)

- Fundamentals of Electroanalytical Techniques.
- Design and modification of working electrodes.
- Enzymatic and Affinity-Based Electrochemical Sensors.
- Advanced materials for signal amplification and sensor stability.
- Miniaturization and integration for portable ECB platforms.
- Case Study: High-sensitivity detection of cardiac troponin using ECBs in emergency medicine.

Module 3: Nanomaterials in Biosensing

- Synthesis and application of Nanoparticles in signal enhancement.
- Graphene and Carbon Nanotubes (CNTs) for high-surface-area electrode modification.
- Nanostructure-based transducers for single-molecule detection.
- Surface functionalization and biomolecule immobilization techniques on nanomaterials.
- Safety, toxicity, and regulatory aspects of nanobiosensors.
- Case Study: Using Graphene Field-Effect Transistors for highly selective DNA hybridization detection.

Module 4: Advanced Optical Biosensing

- Surface Plasmon Resonance (SPR).
- Fluorescence, Luminescence, and Chemiluminescence-based biosensors.
- Fiber optic and photonic crystal biosensors.
- Label-free detection methods and their advantages over labeled assays.

- Miniaturized spectrometers and integration into PoC devices.
- Case Study: Drug-target interaction kinetics analysis using Commercial SPR systems in pharmaceutical R&D.

Module 5: Microfluidics and Lab-on-a-Chip (LoC)

- Principles of Microchannel Design and fluidic control
- Materials and Fabrication Techniques for LoC
- Integrating sample preparation, reaction, and detection on a single chip.
- Multiplexed Assays and high-throughput screening using LoC.
- Digital microfluidics and sample-to-answer systems.
- Case Study: A Centrifugal Microfluidic device for fully automated blood analysis in resource-limited settings.

Module 6: Wearable and Implantable Biodevices

- Design challenges for flexible electronics and on-skin adhesion.
- Sensing physiological parameters and biomarkers.
- Power management and wireless data transmission
- Biocompatibility, biofouling, and long-term stability of implantable sensors.
- User interface design and human factors for wearable technology.
- Case Study: Developing a smart contact lens for continuous intraocular pressure or glucose monitoring.

Module 7: Point-of-Care (PoC) Diagnostics

- The "ASSURED" criteria for PoC device development
- Lateral Flow Immunoassays (LFIA) and their advanced variants.
- Developing handheld, battery-powered readers and companion apps.
- Minimizing matrix effects and sample preparation at the PoC.
- Regulatory approval and clinical validation strategies for PoC systems.
- Case Study: A Smartphone-based diagnostic platform for rapid detection of infectious disease using a PoC device.

Module 8: Biosensors in Liquid Biopsy

- Target Analytes: ctDNA, circulating tumor cells (CTCs), Exosomes, and miRNAs.
- Capture and Enrichment techniques for rare analytes in complex samples.
- Sensing approaches for low-concentration tumor biomarkers.
- Integration of biosensing with next-generation sequencing (NGS) platforms.
- Clinical utility and challenges in cancer diagnosis and monitoring.
- Case Study: Development of a microfluidic chip for the isolation and electrochemical analysis of ctDNA fragments for early cancer detection.

Module 9: AI and Machine Learning in Biosensing

- Data acquisition, pre-processing, and feature extraction from sensor signals.
- Supervised and Unsupervised Learning models for biomarker classification.
- Deep Learning for pattern recognition and artifact rejection in continuous monitoring data.
- Integrating AI for predictive diagnostics and personalized treatment recommendations.
- Ethical considerations and data security in IoT-integrated health data.

- Case Study: Using a CNN (Convolutional Neural Network) to interpret images from a colorimetric array biosensor for improved pathogen identification.

Module 10: Advanced Biorecognition Technologies

- Phage Display for selecting high-affinity peptide and protein ligands.
- Molecularly Imprinted Polymers (MIPs) as robust, synthetic recognition elements.
- CRISPR-Cas Systems for highly specific nucleic acid sensing.
- Developing whole-cell biosensors for toxicity and environmental monitoring.
- Rational design and computational modeling of novel bioreceptors.
- Case Study: Utilizing CRISPR-based diagnostics on a paper-based assay for rapid and low-cost virus detection.

Module 11: Biosensors for Environmental and Food Safety

- Detection of pollutants, heavy metals, and toxins in water and air.
- Biosensors for rapid on-site pathogen and bacterial contamination testing in food.
- Authentication of food origin and prevention of food fraud using sensor arrays.
- Regulatory standards and field deployment challenges for environmental sensors.
- Developing robust, reusable, and inexpensive sensors for industrial use.
- Case Study: Electrochemical biosensor array for simultaneous detection of multiple heavy metal ions in drinking water.

Module 12: Sensor Fabrication and Micro/Nanofabrication Techniques

- Photolithography and soft lithography for microdevice patterning.
- Thin-film deposition and etching techniques.
- 3D Printing and rapid prototyping of custom biodevices and fluidic components.
- Integration of materials, electrodes, and microfluidics into a final device.
- Quality control and large-scale manufacturing considerations.
- Case Study: Process flow and materials selection for manufacturing millions of screen-printed glucose test strips.

Module 13: Data Analysis, Signal Processing, and IoT Integration

- Analog-to-Digital Conversion (ADC) and fundamental signal processing.
- Noise reduction, filtering, and drift compensation algorithms.
- Principles of Wireless Body Area Networks (WBAN) and sensor networking.
- Data transmission protocols and cloud-based storage for health monitoring.
- Ensuring data security and system reliability.
- Case Study: Designing the data pipeline for a wearable ECG/temperature patch for continuous monitoring and alert generation.

Module 14: Regulatory Landscape and Commercialization Strategy

- Overview of FDA (510(k), PMA) and CE Mark requirements for medical devices.
- Quality Management Systems (QMS) and ISO standards (ISO 13485).
- Intellectual Property (IP) strategy: Patents, trade secrets, and licensing.
- Market analysis, competitor review, and value proposition development for a new biodevice.
- Clinical trial design and post-market surveillance.
- Case Study: Navigating the FDA approval process for a novel Lab-on-a-Chip sepsis diagnostic device.

Module 15: Capstone Project: Advanced Biodevice Design and Prototyping

- Project planning: Defining a problem statement and technical specifications.
- Literature review and competitive technology analysis.
- Detailed technical design of a new advanced biosensor/biodevice
- Virtual or physical prototyping and simulated/real data analysis.
- Presentation of the final design, business case, and commercialization roadmap.
- Case Study: The design, validation, and simulated economic feasibility of a Wearable Patch Sensor for continuous stress monitoring via cortisol detection.

Training Methodology

The course adopts an Experiential and Blended Learning approach:

1. Expert-Led Lectures.
2. Practical Workshops/Hands-on Labs.
3. Case Study Analysis.
4. Capstone Project.

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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