Indian Institute of Technology Delhi (IIT Delhi)

Executive Programme for Quantum in ML & AI Systems

Type Executive Program	Mode Online
Duration 6 Months	Total fees ₹ 130,000

UNIVERSITY

Indian Institute of Technology Delhi (IIT Delhi)

Established in 1961 as an Institute of National Importance, the Indian Institute of Technology Delhi (IIT Delhi) is one of India's premier institutions for engineering, technology and research. Renowned for its academic excellence, innovation and global collaborations, the institute fosters interdisciplinary learning and industry-driven research. IIT Delhi is committed to developing future-ready professionals and leaders capable of driving technological advancement and societal impact.

PROGRAM

Executive Programme for Quantum in ML & AI Systems

Highlights

- Build a strong foundation in quantum computing, quantum information science and machine learning.
- Gain hands-on exposure to Qiskit, PennyLane, D-Wave simulators, PyTorch, TensorFlow and VisualQuantum.
- Explore quantum kernels, variational circuits, generative models, optimisation and hybrid quantum-classical workflows.
- Apply concepts through case studies, simulation-based exercises and an end-to-end capstone project.
- Participate in a one-day IIT Delhi campus immersion and earn an e-Certificate from CEP, IIT Delhi upon successful completion.

Learning outcomes

- Interpret core quantum concepts including superposition, entanglement, measurement and noise within intelligent systems.
- Construct and evaluate quantum circuits, feature maps, kernels and quantum-enhanced machine learning models.
- Translate classification, optimisation and modelling problems into quantum-ready representations.
- Design hybrid quantum-classical systems by integrating quantum operations with established ML frameworks.
- Analyse simulator outputs and apply quantum approaches to emerging use cases in optimisation, analytics and intelligent systems.

Eligibility Criteria

Graduation in any of these disciplines: B.Tech/BE; BCA/MCA; B.Sc/M. Sc. in all streams; BA/MA in mathematics

Curriculum Overview

Module 0: Pre-course / Bridge Module (6 subjects)

- Vector spaces, eigenvalues, SVD, tensor operations
- Random variables, distributions, expectation, covariance
- Bayesian inference and estimation
- Supervised vs unsupervised ML, bias–variance trade-off
- Optimization basics (gradient descent, convexity)
- Case Study: Classical-to-Quantum Readiness Assessment

Module I: Quantum AI Systems Foundations (8 subjects)

- Quantum states, Hilbert spaces, operators
- Single- and multi-qubit gates
- Quantum circuits and measurement theory
- Noise models and decoherence
- Data encoding: angle, amplitude, basis encoding
- Variational Quantum Circuits (VQCs)
- Hybrid quantum–classical training loops
- Case Study: Quantum Feature Encoding for Multimodal Data

Curriculum Overview (continued)

Module II: Quantum ML for Scalable Intelligence (9 subjects)

- Quantum kernels and kernel alignment
- QSVM architectures
- Quantum generative models (QGAN, QVAE, QBM)
- Quantum diffusion concepts
- Quantum vision models
- Quantum RNNs, LSTMs, and Transformers
- Circuit pruning and parameter reduction
- Hardware-aware circuit compilation
- Case Study: Quantum Kernel Advantage in Classification

Module III: Quantum Optimization & Decision Systems (6 subjects)

- Combinatorial optimization basics
- QUBO and Ising formulations
- QAOA architecture and parameter optimization
- Constraint handling in quantum optimization
- Quantum annealing principles
- Case Study: Resource Allocation via QAOA

Curriculum Overview (continued)

Module IV: Secure & Deployable Quantum-AI Systems (6 subjects)

- Hybrid quantum-classical learning workflows
- Quantum hardware and noise considerations
- Model performance and evaluation
- Security, privacy, and trust in quantum-AI systems
- Real-world applications and deployment challenges
- Case Study: Federated Quantum Learning for Sensitive Data

Capstone Project: Description (4 subjects)

- Participants work on an end-to-end quantum AI problem integrating encoding, learning, optimization, and deployment considerations.
- Example Capstone Themes: Quantum-inspired multimodal perception systems
- Example Capstone Themes: Quantum optimization for healthcare or logistics
- Example Capstone Themes: Secure federated quantum ML architectures

Fee Structure

Fee heads	Amount
Program Fee	₹ 130,000
Total	**₹ 130,000**