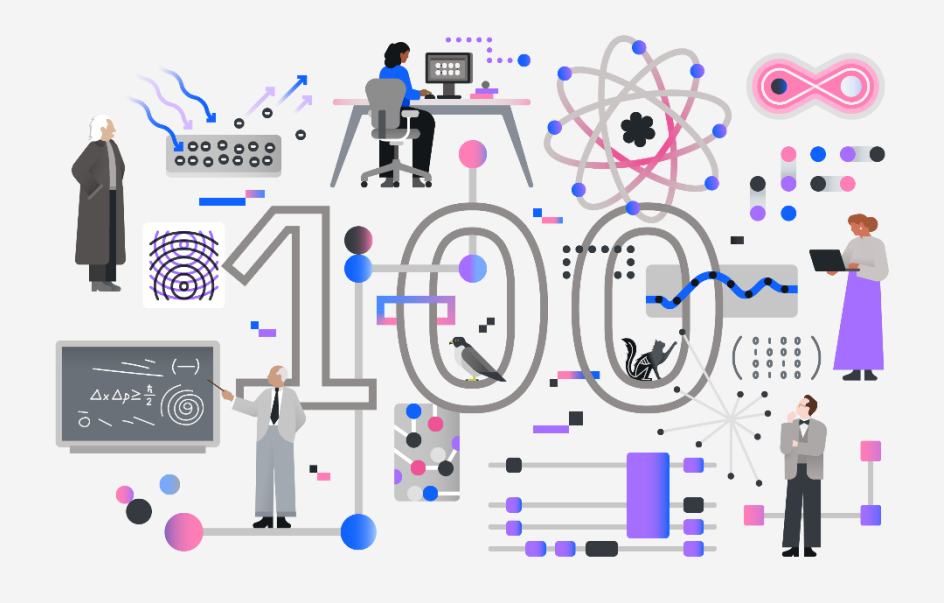
Q-Extreme Hackathon: Participant Guide

- Qiskit Fall Fest 2025 – UCSC ACM Student Chapter –



1. Introduction

Welcome to **Q-Extreme**, Sri Lanka's first-ever quantum computing hackathon! Over the next five days, you will push the boundaries of your quantum knowledge, moving from foundational protocols to advanced quantum chemistry simulations.

This guide outlines the competition format, scoring criteria, and submission guidelines.

2. Timeline

- **Competition Start:** Wednesday, November 19th @ 12:00 PM (IST)
- **Long-Format Challenges (Tasks 1 & 2):** Released at Start. Open until competition closes.
- **Speed Challenge (Task 3):** Sunday, November 23rd @ 12:00 PM (IST).
- **Competition Close:** Sunday, November 23rd @ 11:59 PM (IST).

3. Rules & Conduct

- This is a individual event (as per registration).
- Plagiarism of code or report content will result in immediate disqualification.
- Use of *Qiskit* documentation and open-source resources is encouraged, but the implementation must be your own.

4. Challenge Categories & Scoring

The hackathon consists of three main tasks totaling **100 Points**.

Task 1: Quantum Chemistry & Optimization (40 Points)

Format: Jupyter Notebook (The_Chemist.ipynb)

Notebook Link: *The_Chemist.ipynb (Download the Jupyter Notebook from this link, then open it in Google Colab (recommended) or in your local Jupyter environment.)*

In this task, you will compute the Ground State Energy of Molecules using Sampling-based Quantum Diagonalization (SQD). You will explore methods to construct subspaces to solve the N_2 molecule problem, comparing the **SQD** and **Sample-based Krylov Quantum Diagonalization (SKQD)** methods.

Scoring Breakdown:

- **Exercise 1 (6 Marks):** Defining Active Space & Molecular Properties.
- **Exercise 2 (6 Marks):** Qubit Hamiltonian Mapping.
- **Exercise 3 (6 Marks):** Hardware-Efficient Ansatz (RealAmplitudes).
- **Exercise 4 (6 Marks):** Chemistry-Inspired UCJ Ansatz implementation.
- **Exercise 5 (6 Marks):** Constructing SKQD Circuits.
- **Exercise 6 (10 Marks):** Running the full SKQD Workflow.
    - *Part A (5 Marks):* Circuit execution and Job ID collection.
    - *Part B (5 Marks):* Results retrieval and post-processing.

Task 2: Quantum Cryptography & Research (40 Points)

Format: Jupyter Notebook (The_Cryptographer.ipynb) & Report

Notebook Link: The_Cryptographer.ipynb (Download the Jupyter Notebook from this link, then open it in Google Colab (recommended) or in your local Jupyter environment.)

You will implement the BB84 Quantum Key Distribution protocol. Beyond coding, this task requires a **comprehensive report** analyzing noise, eavesdropping, and robustness solutions.

Scoring Breakdown:

- **Protocol Implementation (10 Marks):** Correct implementation of Alice's preparation, Bob's measurement, key sifting, and error checking.
- **Noise Characterization (5 Marks):** Implementing noise models (depolarizing/amplitude damping) and analyzing error rate thresholds.
- **Eavesdropping Scenario (5 Marks):** Implementing an intercept-resend attack and analyzing detection probabilities.
- **Research & Robustness Report (20 Marks):**
    - Identifying real-world challenges (e.g., photon loss, dark counts).
    - Implementing solutions (e.g., Privacy Amplification, Decoy States).
    - Quality, novelty, and depth of the written report within the notebook.

Task 3: The Speed Round (20 Points)

Format: Timed Challenge (Released Sunday @ 12:00 PM)

This is a time-sensitive round. You will have a **4-hour window** to complete two specific objectives. Points will decay based on the time taken to submit.

1. **Bernstein-Vazirani Oracle (10 Marks):**
    - Implement the oracle for a hidden string.
    - *Metric:* Accuracy + Least Time.
2. **GHZ State Construction (10 Marks):**
    - Create a Greenberger–Horne–Zeilinger (GHZ) state.
    - *Metric:* Least Gate Depth + Least Time

5. Submission Guidelines

1. **File Naming:** Please rename your notebooks as
    - **Task1:** <YourName>_Task1.ipynb
    - **Task2:** < YourName >_Task2.ipynb
2. **Execution:** Ensure all cells in your notebooks are run and outputs are visible before saving.
3. **Platform:** Submission links will be provided via email/Whatsapp upon the start of the event.

Submission Links:
Task 1: https://forms.gle/PBKkkCmQqHGeqg7r9
Task 2: https://forms.gle/yz87WEt9AgTLfA779

Good luck and may your qubits remain coherent!

Happy Hacking,
UCSC ACM Student Chapter
Organizers of Qiskit Fall Fest 2025