Quantum Computing Bootcamp Assignment-3

**Q1. A circuit uses 20 gates, each with an error rate of ϵ=0.03. Estimate the total error rate using the exponential approximation.**

Ans: Given that,

* Number of gates: n=20
* Error rate per gate: ϵ = 0.03

We know that,

**Q2. A code corrects up to t=2 errors. What is its minimum code distance d?**

Ans: Given that,

A code corrects up to t=2 errors

We know that,

**Q3. A qubit in state ∣0⟩ undergoes a depolarizing channel with p=0.15. Compute the output state’s entropy.**

Ans: The qubit depolarizing channel D*p* acts on a density matrix *ρ* as

where *X*,*Y*,*Z* are the Pauli matrices.

For p=0.15,

q=0.2

π=I/2

*ρ* =

Von Neumann Entropy:

**Q4. A surface code with distance d=5 requires how many physical qubits per logical qubit?**

Ans: For square surface code,

**Q5. In the 5-qubit code, how many stabilizer generators are needed to correct single-qubit errors?**

Ans: 5-qubit code encodes 1 logical qubit into 5 physical qubits

Number of stabilizers = n-1 = 5-1=4

**Q6. The Shor code encodes 1 logical qubit into how many physical qubits?**

Ans: D:9

**Q7. What is the primary source of shot noise in quantum devices?**

Ans: B. Discrete electron charges

**Q8. A depolarizing channel with p = 0.1 acts on ∣ 0 ⟩. What is the probability of no error?**

Ans:

**Q9. A phase flip error on a qubit is represented by which operator?**

Ans: C. Z

**Q10. Which noise type dominates at low frequencies in superconducting qubits?**

Ans: B. Pink (1/f) noise

**References:**

* [14.8 Code distance and thresholds | Introduction to Quantum Information Science](https://qubit.guide/14.8-code-distance-and-thresholds.html)
* [qml.DepolarizingChannel — PennyLane 0.41.1 documentation](https://docs.pennylane.ai/en/stable/code/api/pennylane.DepolarizingChannel.html)
* [Pink noise - Wikipedia](https://en.wikipedia.org/wiki/Pink_noise)