

Problem Set #5

Quantum Error Correction
Instructor: Daniel Gottesman

Due Tues., Feb. 20, 2007

Problem #1. Qudit Stabilizer Codes

- a) Give the stabilizer for a family of $[[n, n-2, 2]]_p$ codes for all $p > 2$ prime, $n \geq 3$ (not just even n).
- b) Give the stabilizer for a $[[5, 1, 3]]_7$ polynomial code. (That is, the 5-qudit polynomial code for 7-dimensional qudits.)

Problem #2. Transversal Operations

- a) Find logical X and Z operations for the two encoded qubits of the $[[4, 2, 2]]$ qubit code with stabilizer generators $X \otimes X \otimes X \otimes X$ and $Z \otimes Z \otimes Z \otimes Z$.
- b) Show that transversal H , R , and $CNOT$ (the latter performed between two blocks of the code) are all valid encoded operations on the $[[4, 2, 2]]$ code and determine the logical operation performed by them.
- c) Show that the full mod 7 logical Clifford group can be performed transversally on the $[[5, 1, 3]]_7$ polynomial code from problem 1a. (Hints: It is sufficient to show that a set of generators of the Clifford group can be performed. You will need to do different gates on different qudits in order to get these logical operations.)