EE 520 Homework 4

In Nielsen and Chuang, do the following problems:

Sec 4.5: Exercises 4.41-4.43 (*originally from HW 3*)
Sec 5.1: Exercises 5.4, 5.5 (*originally from HW 3*), 5.7
Sec 5.3: Exercises 5.10, 5.14

Problem 1 (Another Universal Set–*originally Problem 3 from HW 3*)

Show that the controlled-$\left(iR_X(\pi a)\right)$ and controlled-$\left(iR_Z(\pi a)\right)$ gates, with a an irrational number, together form a universal set of quantum gates, provided that ancilla qubits (initialized in states $|0\rangle$ or $|1\rangle$) are available.

Problem 2. Consider the Fourier transform on *n* qubits, as shown in section 5.1 of the book, whose circuit is given on page 219. Suppose that we replace all the controlled-*R* gates for $k > \log(n) + c$ with the identity instead, for some small constant integer *c*. Put a bound on the total error that will result.

Show all work.

Due **Thursday 27 October 2022** before midnight. Please hand in your assignment by uploading it as a PDF file through the Blackboard site.