Physics and Quantum Computing Major: Course List

This document lists the requirements of the proposed Physics and Quantum Computing major in list form, rather than the spreadsheet form of the semester guide. I have tried to list alternate course options (ex. PHYS 0174 vs. PHYS 0475), where known, following the format of the standard physics major. Each course in the major must be passed with a C or better grade.

Mathematics (18 credits)
___MATH 0220 (4 cr.) Analytic Geometry and Calculus 1
___MATH 0230 (4 cr.) Analytic Geometry and Calculus 2
___MATH 0240 (4 cr.) Analytic Geometry and Calculus 3
___MATH 0280, 1180, or 1185 (3 cr.) Linear Algebra
___MATH 0290 or 1270 (3 cr.) Differential Equations

Introductory Physics Courses (9 credits):
___PHYS 0174 (4 cr.) Basic Physics for Science and Engineering 1
___PHYS 0175 (4 cr.) Basic Physics for Science and Engineering 2
OR
___PHYS 0475 (4 cr.) UHC Introduction to Physics for Science and Engineering 1
___PHYS 0476 (4 cr.) UHC Introduction to Physics for Science and Engineering 2
AND
___PHYS 0330 (1 cr.) Introduction to Physics, Computer Science, and Quantum Information. This is a proposed 1 hour seminar course drawing speakers from CS, Physics, and other departments.

Introductory and Intermediate Computer Science (13 credits):
___CS 0401 (4 cr.) Intermediate Programming
___CS 0441 (3 cr.) Discrete Structures for CS
___CS 0445 (3 cr.) Algorithms and Data Structures 1
___CS 0447 (3 cr.) Computer Organization

Intermediate and Advanced Physics Courses (16 credits):
___PHYS 0477 (4 cr.) Introduction to Thermodynamics, Relativity, and Quantum Theory
___PHYS 1331 (3 cr.) Mechanics
___PHYS 1341 (3 cr.) Thermodynamics and Statistical Mechanics
___PHYS 1351 (3 cr.) Intermediate Electricity/Magnetism
___PHYS 1370 (3 cr.) Introduction to Quantum Mechanics 1

Advanced Computer Science (9 credits)
___CS 1501 (3 cr.) Algorithms and Data Structures 2
CS 1502 (3 cr.) Formal Methods in Computer Science
CS 1613 (3 cr.) Quantum Computer Science (see proposed syllabus)

Physics Laboratory Courses (at least 5 credits)
Five credits must be chosen from the following:
PHYS 0219 (2 cr.) Basic Lab. Physics OR PHYS 0520 (3 cr.) Modern Physical Measurements
PHYS 0525 (3 cr.) Analog and Digital Electronics
PHYS 1361 (3 cr.) Wave Motion and Optics
PHYS 1426 (2 cr.) Modern Physics Laboratory
PHYS 1415 (2 cr.) Quantum Physics at the Nanoscale

Capstone Research or Project or Internship (3 credits)
All majors must complete a capstone experience prior to graduation. It is the intention that this mirror the format of the CS capstone project (physics lacks an equivalent, though directed research is common among physics undergraduates). The requirement can be satisfied by one semester of directed research with a physics or CS faculty member, or a CS Capstone Project (CS 1980, CS 1981). Alternately, students may instead undertake an internship (for CS this requires registration in CS 1900). There are growing opportunities for QC-specific undergraduate fellowships that may be of interest to majors, see for example: https://www.ibm.com/quantum-computing/internship/ and the various programs linked there.

OPTIONAL Focus in Computer Science or Physics (9 credits):
This group of courses is designed to prepare interested students for graduate studies in CS or Physics, and can also allow for the addition of specialized special topic or elective courses to the major given adequate enrollment and departmental resources. Currently the courses for the focus options are:
PHYS 1371 (3 cr.) Introduction to Quantum Mechanics 2
PHYS 1372 (3 cr.) Electromagnetic Theory
PHYS 1373 (3 cr.) Mathematical Methods in Physics
OR
Three CS courses (9 cr. total) at 1500 level or above.