课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	PHY5032/量子计算 Quantum Computation
2.	**课程性质** **Compulsory/Elective**	专业选修课 Elective Course
3.	**课程学分/学时** **Course Credit/Hours**	3/48
4.	**授课语言** **Teaching Language**	中文 Chinese
5.	**授课教师** **Instructor(s)**	李俊等
6.	**是否面向本科生开放** **Open to undergraduates or not**	是 YES
7.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 量子力学 I Quantum Mechanics PHY206-15

8. 教学目标
Course Objectives

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

量子信息科学为近代物理最前沿和最有发展潜力的学科之一，本课程为研究生及本科高年级学生讲授量子计算的基本概念。

Quantum information science represents one of the most advanced subjects that admits a strong potential for further development. This course aims to prepare graduate and senior undergraduate students for a foundational understanding on the basic knowledge of quantum computation.

9. 教学方法
Teaching Methods

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

本课程以课堂教学为主。全英文教材。致力于建立书本知识和前沿研究的联系。

This course aims to prepare students with the foundational knowledge of quantum computing for their research careers.

10. 教学内容
Course Contents
（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

Section 1	第 1-4 周：量子计算的基本概念：量子力学回顾; 量子态、量子演化、量子测量; 量子纠缠等 Week 1-4: Basic concepts; Quantum mechanics review; Quantum state, evolutionand measurement; Quantum entanglement

	Section 2	第 5-7 周：量子计算的理论基础：经典和量子计算模型；量子线路；量子算法；经典和量子计算复杂性 Week 5-7: Principle: Classical and quantum computational model; Quantum circuit; Quantum algorithm; Computational complexity
	Section 3	第 8 周：期中考试 Week 8: Mid-term exam
	Section 4	第 9-10 周：量子计算的物理实现：比特和门的物理方案；二、三能级系统；自旋模型；Jaynes-Cummings 模型；基本操控技术等 Week 9-10: Physical realization: Qubit and gate schemes; Two/three level systems; Spin model; Jaynes-Cummings model；Basic control techniques
	Section 5	第 11-12 周：量子计算机的实际刻画：噪声机制和刻画；量子层析；量子表征 Week 11-12: Characterization: Noise mechanisms and characterization; Quantum tomography; Quantum benchmarking
	Section 6	第 13-14 周：可扩展量子计算：量子纠错 Week 13-14: Scalability: Quantum error correction
	Section 7	第 15-16 周：量子计算的应用：实验最新进展；量子机器学习；量子多体系统的量子模拟 Week 15-16: Application: Experimental progress; Quantum machine learning; Quantum simulation of quantum many body systems

11. 课程考核
Course Assessment

（① 考核形式 Form of examination；②.分数构成 grading policy；③ 如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）

平时作业 20%，两小时期中考试 30%，两小时期末考试 50%

Assignments 20%; 2-hour mid-term examination 30%；2-hour final examination 50%

12. 教材及其它参考资料
Textbook and Supplementary Readings

Nielsen, M. A. & Chuang, I. L. Quantum Computation and Quantum Information: 10th Anniversary Edition. (Cambridge University Press, 2011).