

课程大纲

COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	超导物理 II Physics of Superconductivity II
2.	课程性质 Compulsory/Elective	专业选修课 Elective
3.	课程学分/学时 Course Credit/Hours	1/16
4.	授课语言 Teaching Language	中文 Chinese
5.	授课教师 Instructor(s)	刘荧
6.	是否面向本科生开放 Open to undergraduates or not	是 Yes
7.	先修要求 Pre-requisites	<p>(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.)</p> <p>电动力学 II Electrodynamics II, PHY208 量子力学 II Quantum Mechanics II, PHY305 统计物理 II Statistical Mechanics II, PHY303</p>
8.	教学目标 Course Objectives	<p>(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.)</p> <p>The objectives of the course are (i) to follow up and expand the contents taught in Physics of Superconductivity I taught by Prof. Tony Leggett; (ii) to help students develop basic understanding of the fundamental physics of superconductivity, in particular, unconventional superconductivity; and (iii) to prepare graduate and advanced undergraduate students for the task of carrying out research in the field of superconductivity.</p>
9.	教学方法 Teaching Methods	<p>(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.)</p> <p>This weekly course comprises in-person and remote lectures given by Prof. Ying Liu. While graduate and undergraduate students will participate the course the same way mostly, more special attention will be paid to potential gaps in course preparation of undergraduate students.</p>
10.	教学内容 Course Contents	<p>(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.)</p>
	Section 1	Cooper pair formation enabled by the electron-phonon interaction
	Section 2	Cooper pair formation enabled by non-electron-phonon interactions
	Section 3	Symmetry of the BCS wave function: The s-wave pairing
	Section 4	Beyond the s-wave pairing

	Section 5	Ginzburg-Landau (GL) theory
	Section 6	Normal state and electron-electron interactions
	Section 7	BCS theory ($T = 0$)
	Section 8	BCS theory at finite temperatures
	Section 9	Brief introduction of group theory and irreducible representation
	Section 10	Symmetry breaking in superconductors
	Section 11	Discovery of unconventional superconductors
	Section 12	Volovik-Gor'kov theory of unconventional superconductivity
	Section 13	Fundamental properties of unconventional superconductors
	Section 14	Even-parity, spin-singlet superconductivity in high- T_c cuprates
	Section 15	Odd-parity, spin-singlet superconductivity in the ruthenate
	Section 16	Course summary and outlook
11.	课程考核 Course Assessment	
	<p>(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.)</p> <p>The numerical grade will be determined by the following distribution: Homework: $2 \times 30\% = 60\%$ Term paper: 30% Course participation: 10% The result is presented as passed or failed.</p>	
12.	教材及其它参考资料 Textbook and Supplementary Readings	
	<ol style="list-style-type: none"> 1. C. Kittel, Introduction to Solid State Physics, 8th Ed., John Wiley & Sons, Inc., 2005. 2. A. J. Leggett, Quantum Liquids: Bose condensation and Cooper pairing in condensed matter systems (Oxford University Press, 2006). 3. Y. Liu, Lecture slides. 	