Course Code	PHYS8552 (RPG)		
Title	Condensed Matter Physics		
Offering Department	Physics		
Course Co-ordinator	Prof Shizhong ZHANG		
Course Co-ordinator Email	shizhong@hku.hk		
Course Objectives	This course introduces many-body physics in quantum matter. Systems consisting of many particles (bosons or fermions) display novel collective phenomena that individual particles do not have, for example, ferromagnetism and superfluidity. It aims to introduce students the general principles behind these phenomena, such as elementary excitations, spontaneous symmetry breaking, adiabatic theorems, emergent topological phases of matter, etc. Theoretical language useful in the interpretation of experiments, such as linear response theory and response functions, will be discussed. This course is intended for both experimentalists and theorists. While there are no official prerequisites, students who would like to take this course are assumed to have sufficient knowledge on quantum mechanics and statistical mechanics.		
Course Contents & Topics	This course will focus on the phenomena of emergent many-body states that require not only the effect of quantum statistics but also that of inter-particle interaction. Examples include: Ferromagnetism, Fermi liquid, superfluidity, superconductivity, and the quantum Hall states. Some general themes related to these quantum states, such as elementary excitation, Ginzburg-Landau description, spontaneous symmetry breaking, and topological phases of matter will be discussed.		
Course Learning Outcomes (CLO)	On successful completion of this course, students should be able to: CLO 1 understand the general principle of spontaneous symmetry breaking CLO 2 understand the basic properties of superfluidity and superconductivity and their Ginzburg-Landau descriptions CLO 3 understand the many-body phenomena based on many-body wave functions and can describe the elementary excitations on top of it CLO 4 apply response function formalism to understand simple experiments and carry out analysis based on analytic properties of response functions CLO 5 understand the basics of quantum Hall effects		
Pre-requisites (and Co-requisites and Impermissible combinations)	NIL		
Offer in 2025 - 2026	Y 2nd sem	Examination	No Exam
Course Grade	A+ to F		
Grade Descriptors	A: Demonstrate thorough mastery at an advanced level of extensive knowledge and skills required for attaining all the course learning outcomes. Show strong analytical and critical abilities and logical thinking, with evidence of original thought, and ability to apply knowledge to a wide range of complex, familiar and unfamiliar situations. Apply highly effective organizational and presentational skills. B: Demonstrate substantial command of a broad range of knowledge and skills required for attaining at least most of the course learning outcomes. Show evidence of analytical and critical abilities and logical thinking, and ability to apply knowledge to familiar and some unfamiliar situations. Apply effective organizational and presentational skills.		

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<tr><td></td><td colspan="3">C: Demonstrate general but incomplete command of knowledge and skills required for attaining most of the course learning outcomes. Show evidence of some analytical and critical abilities and logical thinking, and ability to apply knowledge to most familiar situations. Apply moderately effective organizational and presentational skills.
D: Demonstrate partial but limited command of knowledge and skills required for attaining some of the course learning outcomes. Show evidence of some coherent and logical thinking, but with limited analytical and critical abilities. Show limited ability to apply knowledge to solve problems. Apply limited or barely effective organizational and presentational skills.
Fail: Demonstrate little or no evidence of command of knowledge and skills required for attaining the course learning outcomes. Lack of analytical and critical abilities, logical and coherent thinking. Show very little or no ability to apply knowledge to solve problems. Organization and presentational skills are minimally effective or ineffective.</td></tr>
<tr><td>Course Type</td><td colspan="3">Lecture-based elective course</td></tr>
<tr><td rowspan="4">Course Teaching & Learning Activities</td><td>Activities</td><td>Details</td><td>No. of Hours</td></tr>
<tr><td>Lectures</td><td></td><td>36</td></tr>
<tr><td>Tutorials</td><td></td><td>12</td></tr>
<tr><td>Reading/Self study</td><td></td><td>80</td></tr>
<tr><td rowspan="3">Assessment Methods and Weighting</td><td>Methods</td><td>Details</td><td>Weighting in final course grade (%)</td></tr>
<tr><td>Assignments</td><td></td><td>40</td></tr>
<tr><td>Essay</td><td></td><td>60</td></tr>
<tr><td>Required/recommended reading and online materials</td><td colspan="3">James F. Annett, Superconductivity, Superfluids, and Condensates, Oxford, 2004
D. Pines and N. Nozieres, Theory of Quantum Liquids, in two volumes, Westview Press, 1994
A.J. Leggett, Quantum Liquids, Oxford, 2006
P. Chaikin and T. Lubensky, Principles of Condensed Matter Physics, Cambridge, 2000
M. Tinkham, Introduction to Superconductivity, 2nd Edition, Dover, 1996
P. de. Gennes, Superconductivity of Metals and Alloys, Westview Press, 1999
D. Yoshioka, The Quantum Hall Effect, Springer, 2002
R.E. Prangle and S. Girvin, The Quantum Hall Effect, Springer, 1989
J.K. Jain, Composite Fermions, Cambridge, 2007
X.-G. Wen, Quantum Field Theory of Many-Body Systems: From the Origin of Sound to an Origin of Light and Electrons, Oxford Graduate Texts, 2007</td></tr>
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