<table>
<tr><td>Course Code</td><td colspan="3">PHYS8552 (RPG)</td></tr>
<tr><td>Title</td><td colspan="3">Condensed matter physics</td></tr>
<tr><td>Offering Department</td><td colspan="3">Physics</td></tr>
<tr><td>Course Co-ordinator</td><td colspan="3">Dr C J Wang Physics</td></tr>
<tr><td>Course Co-ordinator Email</td><td colspan="3">cjwang@hku.hk</td></tr>
<tr><td rowspan="2">Teachers Involved</td><td>Name</td><td>Department</td><td>Percentage</td></tr>
<tr><td>Dr C J Wang</td><td>Physics</td><td>100</td></tr>
<tr><td>Course Objectives</td><td colspan="3">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.</td></tr>
<tr><td>Course Contents & Topics</td><td colspan="3">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.</td></tr>
<tr><td>Course Learning Outcomes (CLO)</td><td colspan="3">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</td></tr>
<tr><td>Pre-requisites (and Co-requisites and Impermissible combinations)</td><td colspan="3">Nil</td></tr>
<tr><td>Offer in 2022 - 2023</td><td>Y 2nd sem</td><td>Examination</td><td>May</td></tr>
<tr><td>Course Grade</td><td colspan="3">Pass or Fail</td></tr>
<tr><td>Grade Descriptors</td><td colspan="3">Pass: 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.
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</td></tr>
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	solve problems. Organization and presentational skills are minimally effective or ineffective.		
Course Type	Lecture-based elective course		
Course Teaching & Learning Activities	Activities	Details	No. of Hours
	Lectures		36
	Tutorials		12
	Reading/Self study		80
Assessment Methods and Weighting	Methods	Details	Weighting in final course grade (%)
	Assignments		40
	Essay		60
Quota	9999 (9999 if no quota)		
Required/recommended reading and online materials	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		