PHYS8552 Physics of Quantum Liquids	
Offering Department	Physics
Course Co-ordinator	Dr. C.J. Wang, Physics < cjwang@hku.hk >
Teachers Involved	Dr. C.J. Wang, Physics
Course Objectives	The collective behavior of systems consisting of many particles (bosons or fermions) gives rise to new states of matter, which emerge at low temperatures where interactions are important. This course aims to introduce the students to those novel quantum states, emphasizing the general themes such as elementary excitations, broken symmetry, hydrodynamic description, and topological properties of condensed matter. Theoretical language useful in the interpretation of experiments, such as response functions, will be discussed. The emphasis will be on a selected few examples that illustrate the above concepts and techniques. The course is intended for both experimentalists and theorists.
Course Contents & Topics	This course will concentrate on the phenomena of emergent many-body states that require not only the effects of quantum mechanics, but also that of quantum statistics to its proper explanation. Examples include: superfluidity, superconductivity and the quantum Hall states. We will emphasize on the interaction effects and discuss the primary feature brought about by the interaction. Some general themes related to these quantum states, such as elementary excitation, Ginzburg-Landau description and symmetry breaking will be discussed.
Course Learning Outcomes	On successful completion of the course, students should be able to: 1. understand the general phenomenology of superfluidity and its definition 2. apply response function formalism to understand simple experiments and carry out analysis based on analytic properties based on response function 3. understand the many-body phenomena based on many-body wave functions and can describe the elementary excitations on top of it.
Pre-requisites	Student should have passed PHYS4351, Advanced Quantum Mechanics,

(and Co-requisites and Impermissible combination)	PHYS4550, Advanced Statistical Mechanics.		
Offer in 2019 - 2020	Y 1st sem	Examination	Dec
Offer in 2020 - 2021	To be confirmed		
Course Grade	Pass/Fail		
Grade Descriptors	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. Apply highly effective lab skills and techniques. Critical use of data and results to draw appropriate and insightful conclusions.	
	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.	
Course Type	Lecture-based elective course		
Course Teaching & Learning Activities	**Activities**	**Details**	**No. of Hours**
	Lectures		36
	Guided studies		12
Assessment Methods and Weighting	**Methods**	**Details**	**Weighting in final course grade (%)**
	Continuous assessment including homework assignments and term paper		100
Required/recommended reading	D. Pines and N. Nozieres, Theory of Quantum Liquids, in two volumes (Westview Press, 1994)		

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
Additional Course Information	---