PHYS 5130 Principles of Thermal and Statistical Physics

Course Instructor: Prof. Pak Ming Hui (SC 209, 3943 6351, pmhui@phy.cuhk.edu.hk)

Scope: This is a course for MSc students. It aims at giving a quick overview and the big picture in thermodynamics and statistical mechanics, and their applications. The emphasis will be more on the logical links among different pieces, what thermodynamics and statistical mechanics can do, and the necessity of the subject in understanding the properties of systems consisting of many entities.

Lectures/Tutorials/Examples/Q&A: Tuesdays and Thursdays (18:30 – 20:15) starting 8 Sept 2020 (except holidays) [please keep your Thursdays 19:30 – 20:15 open for the course]

Zoom Link to Classes on Tuesdays and Thursdays: Login Blackboard and upload the Link

Every week on Tue, Thu, until Dec 3, 2020 [except holidays]

I will stay for a while after class every time to answer your questions. You are also welcome to send in your questions by emails

Teaching Assistant: Mr. San Lam Jack Ng (1155094713@link.cuhk.edu.hk)

TA's Consultation Hours: Fridays 10:30 – 12:15 (starting 11 Sept 2020)

Zoom Link to TA's Consultation Hours (TA will be there to answer your questions)

Login Blackboard and download the Link to TA's Weekly Consultation Hours

If the time is not good for some students, you are welcome to send your questions to TA via emails or book a time with him.

Outline: This is a M.Sc. in Physics course aiming at covering the essential concepts, ideas, and techniques in thermodynamics and statistical mechanics, and the relationship between the two subjects. It will cover the conceptual development of the laws of thermodynamics, including ideas behind energy, temperature, entropy, potentials, and Maxwell's relations. Boltzmann's formula relating the entropy to the number of microstates serves to connect thermodynamics to statistical mechanics. Ensemble theories, partition functions, and the evaluation of physical quantities with selected applications will be discussed. Quantum statistics is illustrated by the physics of Fermi and Bose gases. The idea that interactions would lead to phase transitions will be discussed. Depending on the availability of time, ideas behind magnetic phase transition via the Ising model, mean field theory, and Landau's theory of phase transition are optional topics to be discussed. When a choice is necessary, the focus will be put on the big pictures and concepts than the technical details.

Assessment Scheme (under Covid-19)

Homework: 65% Final Exam (format to the decided): 35%

Learning Materials and Problem Sets

We will use the Physics Department Course Web site AND CUHK's Blackboard system at the same time.

Course materials can be found (will be gradually updated) at the department course webpage site at http://www.phy.cuhk.edu.hk/course/2020-2021/1/phys5130/index.html

- Read course information and Assessment Scheme
- Class notes will be posted in the Download Area (no password necessary)
- Problem Sets will be posted in the Download Area from time to time (will also alert you with emails)
- Must Note: You should **submit your homework using CUHK's Blackboard system** to the homework folder set up for that Problem Set. The system will record your submission time automatically. TA will grade your homework and return graded scripts to you also via Blackboard.
- Your homework must be submitted on or before the due date and cutoff time stated in the Problem Set (call it Time T). There is a buffer of 2 days if you can't submit your work on time (call it T+2). If you submit your work after the due date T but before the T+2 deadline, your work will still be graded but a 20% discount in marks will be applied.
- A book list will be posted separately and later (in Front Matter)
- CUHK has a zero tolerance policy towards academic dishonesty. Very severe disciplinary actions will be imposed for offences. See https://www.cuhk.edu.hk/policy/academichonesty/Eng_htm_files_(2013-14)/index_page2.htm for an overview and https://www.cuhk.edu.hk/policy/academichonesty/Eng_htm_files_(2013-14)/p06.htm for list of offences and guidelines on minimum penalties
- You will be asked to sign and submit an academic honesty declaration form for the homework you will do in this course

How to do well in the course

- Review and clean up topics discussed promptly
- Read class notes on the next topic before attending classes
- Have a device (pen and paper or electronic alternatives) ready that you can write down some notes during classes
- Work out some exercises written on pages in class notes
- Work out questions in problem sets independently (although discussions among students are encouraged)
- Ask TA and me questions (don't let questions pile up)
- Read books in addition to class notes

Pak Ming Hui

7 September 2020