PHYSICS 4500/5450 - ***Introduction to Solid State Physics*** – Spring 2023

MWF 12:00PM - 12:500PM – PHYS 311

Instructor: Marco Buongiorno Nardelli
Department of Physics
Office: 317 Physics
Tel. 940-369-8596
Email: mbn@unt.edu; **URL**: http://ermes.unt.edu

Office hours:
Office hours are WF 11am-12pm in Physics 317 or upon appointment.

Course Description:
This course provides an introductory treatment of the fundamentals of solid state physics. It is intended primarily for graduate and upper undergraduate students in physics and related fields. The primary goal of the course is to prepare students for research in condensed matter physics, chemistry and materials science. The course will make use of digital material (jupyter notebooks, open-source software packages, etc) and introduce the students to the use of computation as an integral component of research in condensed matter physics.

Texts:
Steven H. Simon, The Oxford Solid State Basics (Kindle Edition available on Amazon).
Digital modules (jupyter notebooks) are distributed through Canvas.
Video lectures by S.H. Simon available at https://podcasts.ox.ac.uk/series/oxford-solid-state-basics and linked to in the notebooks

Prerequisites
There are no required prerequisites for this course. However, completion of an undergraduate course in statistical mechanics and quantum mechanics is assumed.
Furthermore, in order to be successful in this course you will need to have a basic computer literacy, including understanding of editors, shells, and installation of computing environments (installation of anaconda python, or equivalent python installation, is required)
You must bring your laptop (or equivalent device) to every class

How this course will work
- Most of the work will be done in class – ATTENDANCE TO CLASS IS MANDATORY and will be recorded!!! You will be evaluated on your participation to class and group discussions (see next on grading)
- All the work will be done in groups – you will be assigned to a group of 3-4 students and groups will be reshuffled for every module
- You will be individually responsible for submitting the assignments (even if the work has been done in group)
- Zero tolerance policy on late assignments submission

Weekly schedule
Due Monday 11:59am: study the material of the week's Module on the textbook/notebook, and watch the video lecture of Prof. Simon
Monday: discussion on the material of the Module, quick warm-up problems, take-aways, ideas, and questions. Go through the notebook
Wednesday: work on the assignments
Friday: detailed discussion on the notebook, computational projects, finish work on assignments
Due Friday 11:59pm: assignments due on Canvas – solutions will be posted on Canvas on Saturday 12:00am.

Grading:

- Weekly group work and participation (assignments and/or computational exercises). Any unjustified absence will count 7 points on the engagement score (see below)
- You will return your assignments individually as jupyter notebooks or pdf documents through Canvas
- Each module exercise set will count a max of 100 points (this includes evaluation of the correctness of the solution (max 79) and the engagement of each group member (max 21)) – final grade will be the sum of all the individual module grades/# of modules
- Groups will be responsible for recording the degree of participation of their members – each student must add their individual participation score to every assignment submission
  These will be no mid-term or final exam

Syllabus:

- Module 1: Specific Heat of Solids - Einstein model
- Module 2: Specific Heat of Solids - Debye model
- Module 3: Electrons in Metals - Drude model
- Module 4: Electrons in Metals - Sommerfeld model
- Module 5: Structure of materials - the periodic table
- Module 6: Structure of materials- chemical bonding
- Module 7: Electrons and phonons in 1 dimension
- Module 8: Electrons and phonons in 1 dimension (many atoms case)
- Module 9: Crystal structure
- Module 10: Reciprocal lattice and x-ray diffraction
- Module 11: Electrons in a periodic potential – nearly free electron model
- Module 12: Electrons in a periodic potential – band structure
- Module 13: Semiconductors physics
- Module 14: Semiconductor devices
- Module 15: Magnetism

Course Technology & Skills

Minimum Technology Requirements

- Computer

Computer Skills & Digital Literacy

- Using Canvas
- Downloading and installing software

Course Policies

Attendance

Because this course involves collaboration, participation is essential to learning. Our project-based activities require you to be actively engaged in discussions and group work. I understand tardiness and absences may occur. If you are late to class, please drop me an email to let me know the circumstances. If you must miss class, please let me know prior to your absence.

Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community. If you are experiencing any symptoms of COVID (https://www.cdc.gov/coronavirus/2019-ncov/symptoms testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.

Inclusivity

Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. We will discuss our classroom's habits of engagement and I also encourage you to review UNT's student code of conduct so that we can all start with the same baseline civility understanding (Code of Student Conduct) (https://deanofstudents.unt.edu/conduct)

Students with disabilities

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information see

the Office of Disability Accommodation website at http://www.unt.edu/oda. You may also contact them by phone at 940.565.4323.

UNT's policy on *Academic Dishonesty* can be found at:
http://www.vpaa.unt.edu/academic-integrity.htm

Drop information is available in the schedule of classes at:
http://registrar.unt.edu/registration/schedule-of-classes

SPOT evaluation
The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available to you on-line at the end of the semester and will provide you with an opportunity to provide feedback to your course instructor. SPOT is considered to be an important part of your participation in this class. In addition to SPOT, there will be a brief in-class course survey during the last two weeks of the semester.
Near the end of the Spring 2022 semester you will receive an email on from "UNT SPOT Course Evaluations via *IASystem* Notification" (no-reply@iasystem.org) with the survey link. Please look for the email in your UNT email inbox. Simply click on the link and complete your survey. After logging in to the my.unt.edu portal, students can access the SPOT survey site by clicking on the SPOT icon. A list of their currently enrolled courses will appear. Students complete each course evaluation independently. During the long terms, the SPOT is open for students to complete two weeks prior to final exams. During the Fall term, the SPOT is open for students to complete six days preceding their final exam. See https://spot.unt.edu/content/fall-2017-8w1-calendar for specific dates and deadlines.