

UNIVERSITY OF VERMONT
DEPARTMENT OF PHYSICS

PHYSICS 341: SOLID STATE PHYSICS

Spring 2023

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| Instructor: Dr. Dennis Clougherty | Time: TR 10:05–11:20 |
| Email: dennis.clougherty+PHYS301@uvm.edu | Place: Lafayette 411 |

Course Description: Introduction to crystal symmetry and the reciprocal lattice. Crystal binding and lattice vibrations. Thermal, electrical, and magnetic properties of solids, free electron theory of metals, and band theory.

Prerequisites: PHYS 214, PHYS 265, PHYS 273 or their equivalents; Instructor permission.

Objectives: Graduate-level understanding of the quantum mechanical origins of the properties of crystalline solids.

Course Personnel:

Ms. Beth Stinebring, administrative assistant (beth.stinebring@uvm.edu).

Office Hours: TR 1:30-2:30 & by appointment.

References:

1. C. Kittel, *Quantum Theory of Solids*, 2nd edition, (Wiley, 1991).
(This is the required text for the course.)
<https://go.uvm.edu/phys301>
2. N. Ashcroft and N. D. Mermin, *Solid State Physics* (Cengage Learning, 1976)
(This standard graduate text has a comprehensive treatment of solid state physics.)
3. M. Marder, *Condensed Matter Physics*, 2nd edition (Wiley, 2015).
4. S. M. Girvin and K. Yang, *Modern Condensed Matter Physics*, (Cambridge University Press, 2019).

Course Outline:

1. Lattice Dynamics
 - (a) Theory of the harmonic crystal
 - (b) Mossbauer effect
 - (c) Neutron diffraction
2. Electronic Structure of Metals
 - (a) Landau theory of Fermi liquids
 - (b) Theory of pseudopotentials
 - (c) Electron dynamics in a magnetic field
3. Superconductivity
 - (a) BCS theory
 - (b) Coherence effects
4. Cooperative Magnetic Phenomena
 - (a) Magnetism of ions
 - (b) Statistical mechanics of a paramagnet
 - (c) Coupling of magnetic ions
 - (d) Molecular field theories
 - (e) Spin waves

Online Resources:

1. Course web site: <https://bb.uvm.edu>
2. UVM Physics web site: <http://www.uvm.edu/physics/>
3. UVM student accessibility services (SAS): <http://www.uvm.edu/access>
4. Prof. Clougherty's web site: <http://go.uvm.edu/dpc/>

Grading Policy:

Homework (40%), Exams (20% each).

Important Dates:

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| Exam #1 | February 14, 2022 |
| Exam #2 | March 7, 2022 |
| Exam #3 | April 20, 2022 |

Please mark these dates in your calendar now. Exams will take precedence over medical appointments, travel plans, athletic events, and other personal activities. If you miss an exam, you will receive a score of zero unless excused by Professor Clougherty prior to the exam. As a general rule, only a verifiable illness is reason to miss an exam.

Accommodations: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. See <http://www.uvm.edu/access> for more information.

Academic Integrity: It is expected that all students will adhere to the University code of academic integrity. Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example, homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.

(<https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf>)