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Faculty of Science Course Syllabus
Department of Physics and Atmospheric Science
PHYC 4230.03 – Intro to Solid-State Physics - Winter 2026

Instructor: Kimberley Hall Email: Kimberley.Hall@dal.ca

Course delivery: Team-based learning in a workshop format. Prerecorded Lectures will be available on Brightspace. The material learned will be reinforced and evaluated within (in-person) Workshops and Help Sessions.

Lectures: Links to prerecorded lectures are posted on brightspace. Each lecture video on average corresponds to a single 50 minute lecture taking into account the time spent for you to pause the video presentation and take notes in your own handwriting, such that an average week of lectures corresponds to 3 modules. After viewing the lecture and taking notes, ask questions as needed during the help sessions to be sure you understand the lectures.

Workshops/Tutorials/Help Sessions: Tuesdays/Thursdays 10:05 am -11:25 pm LSC C234

Teaching Assistants: Jasleen Kaur Jagde (Jasleen.Jagde@dal.ca), Grant Wilbur (grant@dal.ca)

Course Prerequisites: PHYC 3640.03 (Quantum I) and 3210.03 (Statistical Mechanics)

Course Materials:

Textbooks: *Introduction to Solid State Physics,* Charles Kittel
Solid State Physics, Ashcroft & Mermin

Course Assessment:

ASSIGNMENTS: There will be 5 assignments, posted on brightspace, with due dates as shown in the course schedule. For help with your assignments, in-class help sessions will be hosted with dates as shown in the course schedule.

WORKSHOP QUIZES: There will be a quiz given during each workshop. The dates of the workshops are shown in the course schedule.

MIDTERM TEST: There will be a written midterm test to be held during class. The date of the midterm is provided in the course schedule.

FINAL EXAM: There will be a written final exam. The exam will be carried out during the final exam period. It will be scheduled by the registrar.

Marking Scheme: The weight (%) of each assessment component used in calculating your final mark is indicated in the table below. Your mark will automatically be calculated using both Marking Scheme 1 and Marking Scheme 2 and the larger of the two will be assigned as your final grade. Letter grades will be determined using the Faculty of Science grade conversions.

Component	Dates and Other Information	Weight (% of final grade) Marking Scheme 1	Weight (% of final grade) Marking Scheme 2
Assignments	Posted to brightspace	35	35
Workshop Quizzes	Held during workshops – See Course Schedule for dates	15	15
Midterm	In-class – See Course Schedule	20	0
Final Exam	Date/Time TBD	30	50

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Course Policies: Working together on assignments is encouraged, however the work that you submit for assignments must be your own calculations and be written in your own words.
If you miss a midterm or exam for good reason, you must provide acceptable documentation. If you are not able to complete an assignment on time due to illness or other good reason, you must communicate the situation to the instructor prior to the due date and provide acceptable documentation. Extensions without late penalties will be provided at the discretion of the instructor. If an extension is not granted, assignments that are late will have 20% deducted per day after the due date.

Course Description: An introduction to the basic concepts of solid-state physics which are related to the periodic nature of the crystalline lattice. Topics include crystal structure, X-ray diffraction, phonons and lattice vibrations, the free electron theory of metals, energy bands, magnetism and superconductivity.

Course Content:

1. Free Electron Model (Fermi Gas) (Chapter 6, Kittel)
   - Energy levels in 3D
   - Effect of Temperature
   - Heat Capacity
   - Electrical Conductivity
   - Motion in Magnetic fields
   - Thermal Conductivity

2. Crystal Structure (Chapter 1,3, Kittel)
   - Types of bonding (E.g. Ionic, Covalent)
   - Hydrogen Bonds
   - Atomic Radii
   - Periodic arrays of atoms
   - Types of Lattices (2D and 3D)
   - Index system for crystal planes

3. Reciprocal Lattice (Chapter 2, Kittel)
   - Bragg's Law
   - Diffraction
   - Brillouin zones
   - Structure Factors (Lattice and atomic)

4. Energy Bands (Chapter 7, Kittel)
   - Nearly free electron model
   - Bloch Functions
   - Kronig Penney Model
   - Periodic Potential
   - Semiconductors

5. Phonons (Chapter 4,5, Kittel)
   - Crystal Vibrations
   - Monatomic and two-atom bases
   - Elastic waves
   - Phonon Momentum and Inelastic Scattering
   - Heat capacity
   - Thermal Conductivity

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Course Objectives/Learning Outcomes:

Understand and apply concepts of crystal structure in both real and reciprocal space
Use solutions of the Free Electron Model to understand physical properties of crystalline solids
Explain and interpret classifications of crystalline solids based on types of bonding
Understand the origin and impact of quantized thermal vibrations (phonons) on material properties
Apply the concepts of Bragg Scattering to determine the origin of energy bands in solids

DALHOUSIE COMMON GRADE SCALE

A+ (90-100)	**B**+ (77-79)	**C**+ (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding Mi'kmaq and Indigenous Relations (including the Elders in Residence program, Land Acknowledgements, Understanding Our Roots, and much more) can be found at: https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about/mission-vision-values/global-relations.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For

courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/campus_life/ssc.html).

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:
https://www.dal.ca/content/dam/www/about/leadership-and-governance/governing-bodies/code-student-conduct.pdf

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Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/fair-dealing-policy.pdf

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.