

# SPRING 2024 Physics 6333

**Instructor:** Halyna Hodovanets 118 Physics [halyna.hodovanets@mst.edu](mailto:halyna.hodovanets@mst.edu)

**Meeting room and time:** Physics 00127 MWF 11:00-11:50 AM

**Help Sessions:** TBA

**Webpage:** Canvas

**Textbook:** Introduction to solid state physics, 8<sup>th</sup> Ed., Charles Kittel and N.W. Ashcroft and N.D. Mermin “Solid State Physics”

*Additional books:*

G. Burns “Solid State Physics”

C. Kittel “Quantum Theory of Solids”

J. M. Ziman “Principles of the Theory of Solids”

J. Callaway “Quantum Theory of the Solid State”

## **Description of the course:**

This course covers the basics of physics of crystalline materials. You will become familiar with the concepts and terminology of crystal structure, lattice vibration, band structure, and Fermi surfaces. Time permitting, we may cover magnetism, and superconductivity. You will also learn about the physical and thermal properties of materials and how to measure them and how they are reported in the published literature for the intermetallic compounds.

## **Objectives of the course:**

- To increase understanding of solid-state physics and physics of materials
- To lay the foundation for the future studies and/or research in the areas of condensed matter physics
- To become proficient with the basic calculation methods and improve your problem-solving ability
- To be able to read published scientific literature and extract the necessary information

## **Topics to be covered**

Ch. 1: Classification of solids and crystal structures

Ch. 2: Crystallographic techniques: diffraction

Ch. 3: Crystal binding; elastic properties

### *Exam 1*

Ch. 4: Lattice vibrations (phonons I)

Ch. 5: Thermal properties (phonons II)

### *Exam 2*

Ch. 6: Electronic properties of metals. Free electron Fermi gas

Ch. 7: Nearly-free electron model; energy bands, band gaps

Ch. 8: Semiconductors

Ch. 9: Metals; Fermi surface; Tight-binding model

### *Exam 3*

Ch. 11-12: Magnetism or Ch. 10: Superconductivity (Time permitting )

*Final Exam* (cumulative) **Monday May 9<sup>th</sup> 2024 at 7:30 AM-9:30 AM**

**Final grade make up:**

Homework (10 assignments)	30%
Exam 1-3	35%
Project	10%
Final (cumulative)	25%

**Homework:**

- During each Friday class you will be assigned a problem set, which will consist of the end-of-the-chapter problem(s), and questions based on the chapter objectives.
- Neatly handwritten or typed solutions are due on Wednesday of the following week.
- Homework will be accepted only until the end of the class on Friday of the due week (with 50% penalty for turning the assignment after the deadline).
- There will be ten homework assignments during semester.
- At the end of the course one lowest homework grade will be dropped.
- You are encouraged to discuss your homework in groups. However, identical homework solutions will be given a grade zero. Homework created by using ChatGPT or any AI tools need to be clearly labeled as such.

**Project:** At the beginning of the semester, you will be required to pick (or will be assigned) an intermetallic. As we go covering different topics, you will be required to find the corresponding published information on the assigned compound and prepare a power point presentation which you will present at the last class. The power point presentation must contain: crystal structure, x-ray diffraction, band structure, Fermi surface, heat capacity measurements (or phonons dispersion relations) and resistivity measurements. The power point must also include the references.

**Midterm and final exams:**

- Midterm exams will be given during a regular class.
- The cumulative Final exam will be given in our regular lecture room.
- The midterm and the final exams will consist of 1-3 problems like homework.
- Tests are open notes format.
- The lowest out of three midterm exam scores may be dropped.

**Test makeup policy:**

- In exceptional cases of documented medical or personal emergencies, a makeup test will be provided.
- The instructor **MUST** be notified of such an emergency **PIOR** to the test.
- A makeup test will be composed using the same guidelines as the test missed.

**Sick policy:** Should you feel unwell, ill or are unable to attend class or take tests on campus please contact Student Health Services (mstshs@mst.edu), 573-341-4284 and notify the instructor, and do not come to the lecture. The homework due time will not be postponed unless the student is sick for more than a week. In the case the student is sick when the exam is taking place, that exam (except final) will count as the lowest score exam and will be dropped. The instructor must be notified *prior* to the exam.

**Excessive absence:**

- If you miss 3 assignments of any kind, an academic alert will be issued
- If you miss 5 assignments and/or 2 exams you will be dropped from the course for excessive absence

**Final Grade:** The letter grades will be assigned based on the following cut offs (to four significant figures):

A - 89.50% of total possible points

B - 79.50% of total possible points

C - 69.50% of total possible points

D - 59.50% of total possible points

F - less than 59.50% of possible points

The grade cuts are absolute and will not be lowered. Points will not be added to a student's grade to bring it above the cutoff.

**In the event of instructor emergency:** All class meetings will be held via ZOOM synchronously, and all assignments will continue as scheduled. Exams will be held via ZOOM as well. The web-camera will be required to show the work area for proctoring.

**Accessibility and Accommodations**

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on a disability, please contact Student Disability Services at (573) 341-6655, sdsms@mst.edu, visit <http://dss.mst.edu/> for information. You will need to request a letter from Disability Support Services verifying your disability and specifying the accommodation you need and give the letter to Dr. Hodovanets by the end of the second week of classes before accommodation can be arranged. Testing accommodations **require seven-day notice.**

## Class schedule

### January (6 lectures)

S	M	T	W	T	F	S
		16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Homework #1 is due in class on Wednesday

### February (11 lectures)

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
26	26	27	28	29		

Homework #2 is due in class on Wednesday

Exam #1

Homework #3 is due in class on Wednesday

Homework #4 is due in class on Wednesday

### March (9 lectures)

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Homework #5 is due in class on Wednesday

Exam #2

Homework #6 is due in class on Wednesday

### April (11 lectures)

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Homework #7 is due in class on Wednesday

Homework #8 is due in class on Wednesday

Exam #3

Homework #9 is due in class on Wednesday

### May (3 lectures)

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	12	13

Homework #10 is due in class on Wednesday

Final Exam (7:30 am – 9:30 am)

We may deviate from this schedule. Exam and homework material will be adjusted accordingly.

## **Student Honor Code and Academic Integrity**

- All students are expected to follow the [Honor Code](#).
- [The Student Academic Regulations handbook](#) describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism and sabotage (<http://registrar.mst.edu/academicregs/index.html>), any of which will be reported to the physics department chair and Vice Provost for Academic Support.

## **Well-Being and UCARE (<https://go.mst.edu/ucare-report>)**

Any of us may experience strained relationships, increased anxiety, feeling down, alcohol/drug misuse, decreased motivation, challenges with housing and food insecurity, etc. When your mental well-being is negatively impacted, you may struggle academically and personally. If you feel overwhelmed or need support, please make use of S&T's confidential mental health services at no charge. If you are concerned about a friend or would like to consult with a Care Manager, please make a UCARE referral for support and assistance. UCARE is the central point of contact to connect a student who may be experiencing a personal, academic, financial, wellbeing, and/or other concern to support and resources. A referral can be submitted at <https://go.mst.edu/ucare-refer> or by emailing [ucare@mst.edu](mailto:ucare@mst.edu). For urgent matters, check out the after-hour and urgent resources.

**[Writing Center](#)**. The Writing Center's mission is to assist **all students** in their efforts to become better writers, communicators, and critical thinkers. They offer clients structured one-on-one and small-group conversations with peer consultants. Writing Center consultants are fellow students whose strong writing skills and special training allow them to offer meaningful feedback and guidance for any genre of writing. Students, faculty, and staff across all disciplines can make appointments in-person, online, and asynchronously. More information can be found at their website and through email: [writing@mst.edu](mailto:writing@mst.edu).

**[Student Success Center](#)**. The Student Success Center (SSC) supports student development through individualized tutoring, peer-to-peer life skill coaching, and campus programming – all while providing free coffee and hot beverages! The SSC was developed to provide additional assistance for students academically and help bolster non-academic life skills, such as goal setting and time-management. All student Miners are encouraged to utilize the SSC's free services to get timely support and to enhance their S&T Miner Experience. Visit the SSC at 198 Toomey Hall, contact us at [success@mst.edu](mailto:success@mst.edu), or join us on social media [@sandtssc](#). To see the course offerings and times for SSC Tutoring, visit [studentsuccess.mst.edu/tutoring/](https://studentsuccess.mst.edu/tutoring/).

## **[Nondiscrimination, Equity, and Title IX](#)**

Missouri S&T is committed to the safety and well-being of our campus community, and to creating an environment free from discrimination and harassment.

The University does not discriminate on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability,

protected veteran status, and any other status protected by applicable state or federal law. As used in this policy, the word “sex” is also inclusive of the term “gender.”

Additionally, US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Sexual harassment violations of this law include quid pro quo, hostile environment, sexual assault, dating/domestic violence, and stalking. The U.S. Department of Education has stated the prohibition on discrimination on the basis of sex includes sexual orientation and gender identity.

Students who are experiencing pregnancy or pregnancy-related conditions, including the birthing parent and non-birthing parent, have rights protected under Title IX. Students should contact the Office of Equity and Title IX to learn more about their rights and pregnancy-related assistance/accommodations provided by the University to ensure equitable access to University educational programs and activities.

In accordance with the University of Missouri’s Collected Rules and Regulations, all faculty and staff are required to report any information concerning discrimination disclosed through communication including, but not limited to, direct conversation, email, social media, classroom papers and homework exercises to the Equity Officer/Title IX Coordinator.

**Office of Equity and Title IX**

Equity Officer and Title IX Coordinator: Dr. Paul Hirtz

Phone: (573) 341-7734

Location: 900 Innovation Drive, Suite 500

E-mail: [equity@mst.edu](mailto:equity@mst.edu)