

Cover Sheet: Request 11915

PHZ4044

Info

Process	Course New Ugrad/Pro
Status	Pending at PV - University Curriculum Committee (UCC)
Submitter	Selman Hershfield selman@phys.ufl.edu
Created	10/11/2017 2:35:16 PM
Updated	1/16/2018 8:25:54 AM
Description of request	Atomic binding, crystalline structure, diffraction and reciprocal lattice, lattice vibration, phonons, electrons in solids, energy bands, semiconductors.

Actions

Step	Status	Group	User	Comment	Updated
Department	Approved	CLAS - Physics 011616003	Selman Hershfield		11/3/2017
EEconsult.pdf					11/3/2017
MSEconsult.pdf					11/3/2017
College	Recycled	CLAS - College of Liberal Arts and Sciences	Selman Hershfield	conditionally approved. The CCC is concerned that the obligation of registering for the co-requisite could complicate students' ability to complete this course. Could the co-requisite course also be listed as a prerequisite?	12/8/2017
No document changes					
Department	Approved	CLAS - Physics 011616003	Selman Hershfield	Response to the College Curriculum Committee: The Solid State course (the subject of this request) and PHY 4523 Statistical Physics (the corequisite) are both taught only in the Spring semester. Thus, while it is preferable to have already taken Statistical Physics prior to Solid State Physics, this is not practical for most students. It is undesirable to move PHY4523 Statistical Physics to the Fall semester because (1) one of its prerequisites, PHY 3513 Thermal Physics, is most commonly taken in the Fall semester, and (2) such a move would disrupt the current balance of 4000-level Physics courses between the Fall and Spring semesters.	1/6/2018
No document changes					
College	Approved	CLAS - College of Liberal Arts and Sciences	Selman Hershfield		1/16/2018
No document changes					

Step	Status	Group	User	Comment	Updated
University Curriculum Committee	Pending	PV - University Curriculum Committee (UCC)			1/16/2018
No document changes					
Statewide Course Numbering System					
No document changes					
Office of the Registrar					
No document changes					
Student Academic Support System					
No document changes					
Catalog					
No document changes					
College Notified					
No document changes					

Course|New for request 11915

Info

Request: PHZ4044

Description of request: Atomic binding, crystalline structure, diffraction and reciprocal lattice, lattice vibration, phonons, electrons in solids, energy bands, semiconductors.

Submitter: Selman Hershfield selman@phys.ufl.edu

Created: 10/27/2017 3:33:04 PM

Form version: 2

Responses

Recommended PrefixPHZ

Course Level 4

Number 044

Category of Instruction Advanced

Lab Code None

Course Title Introduction to Solid State Physics

Transcript Title Solid State Physics

Degree Type Baccalaureate

Delivery Method(s) 4136 On-Campus

Co-Listing No

Effective Term Earliest Available

Effective Year Earliest Available

Rotating Topic? No

Repeatable Credit? No

Amount of Credit 3

S/U Only? No

Contact Type Regularly Scheduled

Weekly Contact Hours 3

Course Description Atomic binding, crystalline structure, diffraction and reciprocal lattice, lattice vibration, phonons, electrons in solids, energy bands, semiconductors.

Prerequisites PHY 4604 (Introduction to Quantum Mechanics 1)

Co-requisites PHY 4523 (Statistical Physics)

Rationale and Placement in Curriculum This course is an upper level physics elective for Physics majors. Both our BS and BA degrees require Physics electives. This course has been taught for many years in the Spring semester under PHY4905 so it is time that it move from a special topics course to having its own catalog listing. A course covering the same topics, but with a different textbook is listed in the University of Central Florida course catalog as PHZ 4044.

Course Objectives * Apply the band model of electrons in solids to understand the differences between metals, semiconductors, and insulators.

* Distinguish between the Fermi surfaces of different groups of elements as one goes across the periodic table.

* Explain how differences in physical properties are manifest in the Fermi surfaces.

* Mathematically describe different crystal structures in real space and reciprocal space.

* Explain how neutron and x-ray scattering are used to determine crystal structure using the Bragg and von Laue formulations of diffraction.

* Explain what features in the band structure lead to hole transport in semiconductors.

* Mathematically describe how the density of electrons and holes vary in a semiconductor in terms of

donors, acceptors, and Poisson's equation. Explain qualitatively how a p-n junction works.

* Distinguish between different types of magnetism: paramagnetism, diamagnetism, ferromagnetism, and antiferromagnetism.

Course Textbook(s) and/or Other Assigned Reading The Oxford Solid State Basics, Steven H Simon, 2013.

<https://global.oup.com/academic/product/the-oxford-solid-state-basics-9780199680771?cc=us&lang=en&>

Weekly Schedule of Topics The chapters below refer to those in the textbook. The weeks are for the Spring semester.

Week 1: Chapter 1 - About Condensed Matter Physics
Chapter 2 - Specific Heat of Solids: Boltzmann, Einstein, Debye

Week 2: Chapter 3 - Electrons in Metals: Drude Theory

Week 3: Chapter 4 - More Electrons in Metals: Sommerfeld (Free Electron) Theory
Homework 1 due

Week 4: Chapter 5 - The Periodic Table
Chapter 6 - What Holds Solids Together: Chemical Bonding
Chapter 7 - Types of Matter
Homework 2 due

Week 5: Chapter 8 - One Dimensional Model of Compressibility, Sound, and Thermal Expansion
Chapter 9 - Vibrations of a One Dimensional Monatomic Chain

Week 6: Chapter 10 - Vibrations of a One Dimensional Diatomic Chain
Chapter 11 - Tight Binding Chain

Week 7: Chapter 12 - Crystal Structure
Chapter 13 - Reciprocal Lattice, Brillouin Zone, Waves in Crystals
Chapter 14 - Wave Scattering by Crystals
Homework 3 due

Week 8: Chapter 15 - Electrons in a Periodic Potential

Week 9: Chapter 16 - Insulator, Semiconductor, or Metal
Homework 4 due

Week 10: Spring break

Week 11: Chapter 17 - Semiconductors Physics

Week 12: Chapter 18 - Semiconducting Devices

Homework 5 due

Week 13: Chapter 19 - Atomic Magnetism: Para- and Dia-Magnetism

Week 14: Chapter 20 - Magnetic Order

Chapter 22 - Mean Field Theory

Homework 6 due

Term Paper due

Week 15: Special Topics in Condensed Matter and Solid State Physics

Week 16: Oral Exams

Links and Policies Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> .

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. One registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

UF grading policies for assigning grade points:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu> . Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

Campus Resources:

U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352-392-1575 so that a team member can reach out to the students.

Counseling and Wellness Center:

<http://www.counseling.ufl.edu/csc/Default.aspx>, 392-1575.

University Police Department:

392-1111 or 9-1-1 for emergencies. <http://www.police.ufl.edu/>

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

Academic Resources

E-Learning technical support, 352-392-4357 (option 2) or e-mail Learning-support@ufl.edu.

<https://lss.at.ufl.edu/help.shtml> .

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.

<http://www.crc.ufl.edu/>

Library Support, <http://cms.uflib/ufl.edu/ask> . Various ways to receive assistance with respect to using the libraries and finding resources.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

<http://writing.ufl.edu/writing-studio/>

Student Complaints on Campus:

https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf

Grading Scheme Grading is based on four components

Homework	30%
Term Paper	30%
Seminars/Colloquia	10%

Oral Exam	30%

Total	100%

with the following grading scale

A	85% - 100%
A-	80% - 84.99%
B+	75% - 79.99%
B	70% - 74.99%
B-	65% - 69.99%
C+	60% - 64.99%
C	55% - 59.99%
C-	50% - 54.99%
D+	45% - 49.99%
D	40% - 44.99%
D-	35% - 39.99%
E	

0% - 34.99%

Homework

Homework problems will be assigned on a regular basis (see weekly schedule). Students are expected to work on the problems and submit their work individually. Discussion with your colleagues is encouraged but should not be used as a shortcut to completing the assignments. Work must be complete, concise, and clear for full credit.

Term Paper

Students will choose one topic out of the suggested topics in consultation with the instructor and write a comprehensive research paper. There are goals for the term paper: (i) explain in your own words your topic and (ii) relate your chosen topic to the material in this course.

Rubric for term paper:

- * A: Clearly explain their topic at the level of Solid State Physics covered in this course and suggest areas that are beyond this course for learning more.
- * A- or B+: Show substantial understanding of their topic, but with small gaps in connecting the topics in the course to their research topic.
- * B to C+: Good start on the topic, but are missing important connections to the material covered in this course.
- * C-: Show some understanding of their research topic, but a missing clear connections to the material covered in the course. They may also have given some common misconceptions.
- * D: Show only a superficial understanding of their topic with little or no relation to the material covered in this course.
- * E: Show lack of understanding of both the research topic and the material covered in the course.

Oral Exams

There is one oral exam near the end of the semester. Each student will be asked several questions relating to the topics covered in class, in homework assignments, and in the student's term paper.

Rubric for oral exams:

- * A: Answer all questions without referring back to their notes and no help from the instructor.
- * B: Answer the questions after either referring back to their notes or with some help from the instructor. They may also have some minor misunderstandings.

* C: Able to answer the questions with some gaps in understanding after significant help from the instructor.

* D: Only able to answer a few of the questions with major gaps in understanding.

* E: Not able to answer any of the questions.

Seminars/Colloquia

Students will get credit for attending the Condensed Matter Physics Seminars (Mondays at 4pm), Condensed Matter Physics related Colloquia (Thursdays at 4pm), and/or other (chemistry, materials science) seminars or colloquia that are not part of a grade for another course. Each student will submit a 300 word summary of the talk with his/her own questions on the subject (or his/her questions asked during the seminar or colloquium).

Instructor(s) Prof. Mark Meisel

External Consultation Results (departments with potential overlap or interest in proposed course, if any)

Department	<u>ECE</u>	Name and Title	<u>Henry Zmuda, Assoc. Prof.</u>
Phone Number	<u>352 392 0890</u>	E-mail	<u>zmuda@ece.ufl.edu</u>
Comments	<p><u>Phy 4044 - Solid State Physics</u> <u>I looked over the course description and there is very little overlap with what we do in ECE.</u> <u>Henry Zmuda</u></p>		

Department	_____	Name and Title	_____
Phone Number	_____	E-mail	_____
Comments	<p>_____</p>		

Department	_____	Name and Title	_____
Phone Number	_____	E-mail	_____
Comments	<p>_____</p>		

RE: consults for proposed physics elective - Introduction to Solid State Physics

MECHOLSKY,JOHN JOSEPH,JR

Thu 11/2/2017 8:40 AM

To: Hershfield, Selman Philip <selman@phys.ufl.edu>;

Cc: Manuel, Michele <mmanuel@mse.ufl.edu>; Hennig, Richard <rhennig@ufl.edu>;

Dear Selman,

MSE has no objection to your Introduction to Solid State Physics course. Please proceed in getting the course approved.

Jack

John J. Mecholsky, Jr., Ph.D
Professor and Associate Chair
Materials Science & Engineering Department
100 D Rhines Hall
PO Box 116400
University of Florida
Gainesville, FL 32611-6400

Telephone: 352 846 3306

FAX: 352.392.7219

-----Original Message-----

From: Hershfield, Selman Philip

Sent: Wednesday, November 01, 2017 11:37 AM

To: MECHOLSKY,JOHN JOSEPH,JR <jmech@mse.ufl.edu>

Subject: Re: consults for proposed physics elective - Introduction to Solid State Physics

Dear John,

I realize that this is a very busy time in the semester. Has your curriculum committee had a chance to discuss our solid state physics class? I have a consult form from EE, and I think MSE is the other department that might have overlap with this material.

Regards, Selman

Prof. Selman Hershfield
Department of Physics
P.O. Box 118440
Gainesville, FL 32611-8440
Tel: (352)-392-9387
Fax: (352)-392-0524
selman@ufl.edu
<http://www.phys.ufl.edu/~selman/>

From: Manuel, Michele
Sent: Wednesday, October 18, 2017 12:04 PM
To: Hershfield,Selman Philip
Cc: Ingersent,Kevin; MECHOLSKY,JOHN JOSEPH,JR
Subject: Re: consults for proposed physics elective - Introduction to Solid State Physics

Selman,
Let me run this by our curriculum committee to see if they have any comments.
Regards,
Michele

Michele V. Manuel, Ph.D., FASM
Rolf E. Hummel Professor of Electronic Materials and Chair Department of Materials Science and Engineering Nuclear Engineering Program Herbert Wertheim College of Engineering University of Florida
100 Rhines Hall, 549 Gale Lemerand Drive Gainesville, Florida 32611-6400
Phone: 352.846.3780 Fax: 352.392.7219
Department: www.mse.ufl.edu
Research: www.materialsdesigngroup.com

From: Hershfield,Selman Philip
Sent: Tuesday, October 17, 2017 2:04 PM
To: Manuel, Michele
Cc: Ingersent,Kevin
Subject: consults for proposed physics elective - Introduction to Solid State Physics

Dear Prof. Manuel,

We are submitting the paperwork to get our upper level physics elective, Introduction to Solid State Physics, in the undergraduate catalog. It has been taught under PHY4905 for a number of years.

I am writing as a consult for the University Curriculum Committee (see attached file) to see if MSE has any comments. Our class has some overlap with your classes EMA 3413 Electronic Properties of Materials and EMA 4615 Compound Semiconductor Materials, but we focus primarily on the fundamental physics and only discuss applications briefly. I think students could benefit from taking all three classes.

I am enclosing at the bottom of this e-mail a list of topics covered from the textbook, The Oxford Solid State Basics by Steven H. Simon.

Thank you for your assistance.

Sincerely, Selman

The Oxford Solid State Basics

Steven H. Simon

Table of Contents

1. About Condensed Matter Physics

Part I: Solids Without Considering Microscopic Structure: The Early Days of Solid State 2. Specific Heat of Solids: Boltzmann, Einstein, and Debye 3. Electrons in Metals: Drude Theory 4. More Electrons in Metals: Sommerfeld (Free Electron) Theory Part II: Structure of Materials 5. The Periodic Table 6. What Holds Solids Together: Chemical Bonding 7. Types of Matter Part III: Toy Models of Solids in One Dimension 8. One Dimensional Model of Compressibility, Sound, and Thermal Expansion 9. Vibrations of a One Dimensional Monatomic Chain 10. Vibrations of a One Dimensional Diatomic Chain 11. Tight Binding Chain (Interlude and Preview) Part IV: Geometry of Solids 12. Crystal Structure 13. Reciprocal Lattice, Brillouin Zone, Waves in Crystals Part V: Neutron and X-Ray Diffraction 14. Wave Scattering by Crystals Part VI: Electrons in Solids 15. Electrons in a Periodic Potential 16. Insulator, Semiconductor, or Metal 17. Semiconductor Physics 18. Semiconductor Devices Part VII: Magnetism and Mean Field Theories 19. Atomic Magnetism: Para- and Dia-Magnetism 20. Magnetic Order

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