MCSI 340 Winter 2022

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Course Canvas site: https://wwu.instructure.com/courses/1502818

Lectures: Mondays, Wednesdays and Fridays, 12-1 pm, in CF025.
The first week of the quarter will be via Zoom only. For the rest of the quarter, lectures will be simultaneously given in-person and via Zoom. Video recordings of the Zoom meetings will also be posted on Canvas.

Zoom meeting link: https://wwu-edu.zoom.us/j/95101721595

Office Hours: Please call or email to set up a meeting time with me.

COVID-19 Safety Information (From wwu.edu/teachinghndbook)
Due to the ongoing risk of community spread of COVID-19, WWU students are reminded that proper use of masks is required in all indoor spaces on campus and WWU transportation. Your cooperation will play an important role in preventing COVID-19 transmission and keeping our classroom spaces open for face-to-face instruction. You should stay home if you have any possible COVID-19 symptoms. If you have symptoms and need to stay home, or if you are instructed to isolate due to a positive COVID-19 diagnosis or close contact with a diagnosed person, you should contact your instructor to make alternate arrangements for completing assigned class work.If you disregard this mandate (including anyone wearing a mask improperly) you are potentially putting your classmates at risk, which is against the expectations of the WWU Student Code of Conduct. If a faculty member identifies an unsafe situation in the class, they have the authority to tell any student contributing to the problem to change their unsafe behavior or, failing that, to direct the student to leave the place where the class is taking place.

Student Learning Outcomes
Upon completion of this course, students will:
(i) have gained a broad perspective on materials chemistry and physics
(ii) have gained an introduction to the electronic, magnetic, optical properties of bulk and nano-structured materials
(iii) have gained an introduction to a variety of nanomaterials, including computational modeling of their mechanical, electronic, magnetic, and optical properties.
(iv) have obtained experience in performing in-depth research into a topic in materials science and summarizing their findings in written and oral reports.

Reference Material:
The primary text for the course is Rethwisch, D.G.; Callister, W.D.; *Fundamentals of Materials Science and Engineering: An integrated Approach*, 5th edition, New York: Wiley, 2015. ISBN 978-1-119-17548-3 (3rd and 4th editions may be used instead). A few of this text is on reserve in the WWU library. Readings from other sources will be assigned as the course proceeds and will be made available to you through the course webpage and/or Canvas page.

The course's Canvas site contains links to assignment questions, solutions for assignments and tests, lists of material you will be responsible for on tests, photographs/videos of some of the classroom demonstrations, etc.

Approximate Schedule (as of January 2022) : Check back regularly. This schedule will be updated continually throughout the quarter.

Week	Dates	Topics	Reading
1	Jan 4-7	Review: electric and magnetic fields, electronic bands, conductors, insulators, semiconductors	review of Phys163 C&R 12.1-6
2	Jan 10-14	Current, current density, Ohms Law, resistivity, drift velocity, mobility, conductivity in metals, **Lab demonstration 1**: Resistivity: room temperature values and temperature dependence for metals, amorphous alloys (metglass), semiconductors	review of Phys163 C&R 12.7
3	Jan 17-21 (MLK Mon)	Matthiesens rule, Nordheim's rule, temperature dependence of conductivity, types of semiconductors (intrinsic and extrinsic), interpolating log plots, pn junctions (diodes and transistors), factors affecting conductivity in semiconductors	C&R 12.8 12.10-13 12.15
4	Jan 24-28	Hall Effect (Hall voltage, Hall coefficient) Thermal properties: heat capacity (lattice, electronic, temperature dependence. The Debye temperature.) , Seebeck and Peltier effects, superconductivity **Lab demonstration 2**: Diodes, Transistors, the Hall Effect	C&R 12.14
5	Jan 31-Feb4	Thermal expansion, thermal conductivity Magnetic fields review (Lorentz force and sources of the field)	C&R 17.1-4
6	Feb 7-11	**Midterm test: Wednesday, February 9, 12-1pm** The vectors B and H, magnetic permeability, magnetization, susceptibility, sources of magnetization. Types of magnetization (dia, para, ferro, antiferro, ferri) **Lab demonstration 3**: Thermal conductivity, Seebeck and Peltier effects, Magnetic torque (D-cell motor, measuring dipole moment by (i) balancing magnetic and gravitational torques, (ii) measuring a dipole oscillation frequency, (iii) measuring dipole precession frequency), superconductors	C&R 18.1-5
7	Feb 14-18	Ferromagnetism details (Temperature dependence, Curie temperature, susceptibility, domains, hysteresis, soft and hard materials)	C&R 18.6-7
8	Feb 21-25 (Pres. Day Mon)	Magnetic materials: example parameters, Nanomagnetism (sputtering, MBE, Giant Magnetoresistance materials) Optical properties: Maxwell's equations and Electromagnetic waves (wavelength, frequency, intensity, speed). Photons (mass, momentum, energy, speed, intensity),	C&R 19.1-5 C&R 19.6-10
9	Feb 28-Mar4	Light in matter: index of refraction, wavelength, Snell's law, total internal reflection, refraction, dispersion, polarization and Malus' Law, Faraday effect, optical isolators, magnetooptical Kerr effect, photoconductivity, solar cells, light emitting diodes. Diffusion mechanisms, Fick's First and Second laws, Factors that influence diffusion, diffusion in semiconducting materials. **Lab demonstration 4**: Snell's law, Malus' law, Faraday Effect **Student Presentations**	
10	Mar 7-11	**Student Presentations**	
Exam week		**Final Exam: Monday, March 14, 3:30-5:30**	

Research Topic: You will choose a topic in materials science to research over the course of the quarter. At the end of the quarter you will be asked to submit a short paper (800-1200 words) summarizing your findings and to make a brief oral report to the class (10 minutes to present + 2 minutes for questions). You will also be required to read the papers of other students, submit two questions to a discussion on Canvas, and take part in a question and answer session during oral presentations.

Labs/demonstrations:
The course will include a number of hands-on labs/demonstrations relating to material covered in the lectures. Please take notes on these activities and feel free to ask lots of questions. The Canvas site has links to videos of the demos and/or brief descriptions. Some weekly assignment and/or test questions will be based on the labs/demonstrations.

Homework:
5-10 homework problems will be assigned via Canvas per week. Collaboration on assignments is fine. But please write up/hand in your own solutions! These problems will be due on the indicated due date **before the beginning of class**. If possible, please submit your completed solutions on paper. If necessary, you may alternatively submit the assignments **via Canvas or email**, but please make sure your submission is a **single pdf file**. If you are unsure about how to convert photos or other file fomats to pdf files please contact me in advance of the homework due date.

Exams:
There will be one midterm test and a cumulative Final Exam. Both will be in-person. Both quantitative and qualitative questions will be asked. The midterm test will be allotted 1 hour, and the final exam will be 2 hours. **Please prepare an Equation Summary sheet for use while doing the test/exam**. The Equation Sheet may contain only equations, and/or short two or three-word phrases, and it must be your own compilation of hand-written equations, significantly different from the sheets of other students in the class. Provided the sheet is accurate, unique, and comprehensive, it will be counted as an automatic 10% toward your test/exam grade. Be sure to attach the equation sheet to the rest of your work when hand in the test.

maximum equation sheet size	
midterm test	final exam
single side 8.5” x 11”	two sides 8.5” x 11”

Grades:

Homework	Test 1	Research paper	Oral presentation	Paper Peer Review: canvas questions and attendance/participation in Q&A sessions	Final Exam
25%	25%	10%	10%	5%	25%

Percentage	90-100	85-89	80-84	77-79	73-76	70-72	67-69	63-66	60-62	57-59	53-56
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-

Covid-19, Accomodations, and General WWU policies

The covid-19 pandemic is taking a toll on all of us. Please let us know if you have circumstances that require accommodations and we will our best to help. If you have ideas on how to make the course run more smoothly please feel free to offer suggestions!

Please read the document https://syllabi.wwu.edu/ for information on covid-19 related accommodations as well as complete information on general WWU topics such as Academic Honesty, Accommodations, Ethical Computing Resources Conduct, Equal Opportunity, Finals, and the Student Conduct Code.