

## Syllabus | MSE 500 | Spring 2024

### Course

**Institution:** North Carolina State University

**Title:** Materials Science and Engineering (MSE) 500 | Modern Concepts in Materials Science

**Credits:** 3

**Sections:** Local (301) and distance education (601)

**Description:** “Fundamentals of structure, structure modification and properties of materials with emphasis on structure-property relationships and modern theory of solids”

### **Learning outcomes:**

- Discuss, understand, and compare the structure of crystalline and amorphous solids
- Identify the structure and chemistry of point, line, and planar defects in solids
- Read and interpret unary and binary phase diagrams
- Understand the crystalline lattice and the nomenclature used to describe it
- Articulate the physical properties associated with ceramic, semiconducting, metallic, and amorphous solids
- Understand the roles of thermodynamics and kinetics in regulating phase transitions

**Course structure:** This course will be completely online in an asynchronous format; all lectures, assignments, and take-home exams will be obtained via **Moodle**. Therefore, there will be **no in-person/virtual meeting dates and times**. Course material can be accessed each week whenever one is able to do so, including prerecorded lectures via **Panopto**, lecture slides, the textbook, etc.; however, there will be homework assignments, exams, and course participation tasks due during the semester.

**Textbook:** Callister, William D. & Rethwisch, David G. Materials Science and Engineering: An Introduction, 10<sup>th</sup> Edition. Hoboken, NJ:Wiley.

Other recent editions (8<sup>th</sup> and 9<sup>th</sup>) would be okay as well. Earlier editions may also be fine, but please keep in mind that there may be some differences. Depending on the edition, this textbook may be available in a printed format and/or a digital format (e-book). NC State is providing **temporary free access** to the 10<sup>th</sup> edition of the e-book through its **All-In Digital Textbook program** up to **Jan. 23<sup>rd</sup>, 2024**. During this free-access period, one will have the option to purchase this e-book from NC State at a discounted price, listed at **\$80.50 (lifetime access)**, if purchased **before Jan. 23<sup>rd</sup>**. This is one option available; the textbook could be purchased, rented, or checked out/borrowed elsewhere, depending on one’s preference.

**Prerequisites:** Graduate standing

**Instructor of record:** Albert Kwansa | **E-mail:** alkwansa@ncsu.edu | **Office hours:** By e-mail

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**Tentative schedule**

First and last days of classes: Jan. 8<sup>th</sup> and Apr. 23<sup>rd</sup>

Final exam week: Apr. 25<sup>th</sup> to May 1<sup>st</sup>

Date	Lecture #	Topic	Chapter	HW
<b>M/Jan. 8</b>	--	<b>First day of classes</b>	--	
<b>T/Jan. 9</b>	1	Introduction	1	
<b>R/Jan. 11</b>	2	Atomic structure and interatomic bonding	2	
<b>T/Jan. 16</b>	3	Structure of crystalline solids	3	
<b>R/Jan. 18</b>	4	Structure of crystalline solids	3	1
<b>T/Jan. 23</b>	5	Imperfections in solids	4	
<b>R/Jan. 25</b>	6	Imperfections in solids	4	
<b>T/Jan. 30</b>	7	Diffusion	5	
<b>R/Feb. 1</b>	8	Diffusion	5	2
<b>T/Feb. 6</b>	9	Mechanical properties	6	
<b>R/Feb. 8</b>	10	Mechanical properties	6	3
<b>T/Feb. 13</b>	--	<b>Wellness day</b>	--	
<b>R/Feb. 15</b>	--	No lecture (extra day for HW3)	--	
<b>T/Feb. 20</b>	11	Review for midterm exam	--	
<b>R/Feb. 22*</b>	--	<b>Midterm exam</b>	--	
<b>T/Feb. 27</b>	12	Phase diagrams	9	
<b>R/Feb. 29</b>	13	Phase diagrams	9	
<b>M/Mar. 4</b>	--	<b>Drop/revision deadline</b>	--	
<b>T/Mar. 5</b>	14	Phase diagrams	9	4
<b>R/Mar. 7</b>	15	Phase transformations	10	
<b>Mar. 11-15</b>	--	<b>Spring break</b>	--	
<b>T/Mar. 19</b>	16	Phase transformations	10	
<b>R/Mar. 21</b>	17	Phase transformations	10	5
<b>T/Mar. 26</b>	18	Applications and processing of metals	11	
<b>R/Mar. 28</b>	19	Structures & properties of ceramics	12	
<b>T/Apr. 2</b>	20	Polymer structures/Characteristics, applications, & processing of polymers	14/15	6
<b>R/Apr. 4</b>	21	Electrical properties	18	
<b>T/Apr. 9</b>	22	Magnetic properties	20	
<b>R/Apr. 11</b>	23	Optical properties	21	7
<b>T/Apr. 16, R/Apr. 18</b>	--	No lectures (extra days for HW7)	--	
<b>T/Apr. 23</b>	24	Review for final exam	--	
<b>T/Apr. 23</b>	--	<b>Last day of classes</b>	--	
<b>R/Apr. 25*</b>	--	<b>Final exam</b>	--	

For the first column, M = Mon., T = Tues., and R = Thurs. "HW" column = Tentative dates when homework assignments (HWs) would be given. \*Alternative exam dates may be possible.

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### Grade components:

Homework assignments	20% (excluding one lowest-scoring assignment)
Course participation Moodle forum	10%
Midterm exam	35%
Final exam	35%

- Homework assignments (HWs):** Tentatively, seven homework assignments are planned for the semester and will be based on the textbook. HWs will be graded based on both effort and correctness; however, most of the points will be based on showing work, including reasonable units (if applicable), and using expected notations (if applicable).
- Course participation:** There will be a course participation Moodle forum. For each half of the course (before and after the midterm exam), each participant is requested to start at least one substantive forum thread about a course topic and to post at least one substantive reply in another participant's thread or in one's own thread (i.e., each participant would have at least four posts total for the entire semester – 1 new thread and 1 reply for the 1<sup>st</sup> half of the course and 1 new thread and 1 reply for the 2<sup>nd</sup> half of the course). These “substantive” posts will be graded based on completeness (meeting a set of criteria described at the top of the forum) and effort (not correctness).
- Exams:** All exams will be take-home (open-book/note), non-cumulative exams. Similar to the HWs, exams will be graded based on both effort and correctness.
- Access and submission methods:** All HWs and exams will be accessible via Moodle within an HW/exam module or section. One would download the PDF document, complete the HW/exam, and then upload a single PDF of responses for the HW/exam. If printing and completing the HW/exam by hand, one can use a scanner, scanner app, etc. to prepare a single PDF; please confirm that the scanned content is clear and legible.
- Timing:** Unless noted otherwise, HWs are intended to be due within one week from the date given/assigned. For example, the 1<sup>st</sup> HW (covering lectures 1 to 4) will be tentatively given on Thurs., Jan. 18<sup>th</sup> and will be tentatively due by 11:59 pm ET on Wed., Jan. 24<sup>th</sup>. A 36-hour time window is tentatively planned for the exams. Given and due dates/times will be posted on the Moodle course site.

### Letter grades (numerical total will be tentatively rounded to the nearest integer):

$98 \leq A+ \leq 100\%$	$88 \leq B+ < 90$	$78 \leq C+ < 80$	$68 \leq D+ < 70$	$0 \leq F < 60$
$92 \leq A < 98$	$82 \leq B < 88$	$72 \leq C < 78$	$62 \leq D < 68$	
$90 \leq A- < 92$	$80 \leq B- < 82$	$70 \leq C- < 72$	$60 \leq D- < 62$	

### Requirements for credit-only (S/U) grading:

“Courses at the 500 and 700 level are letter graded. Students cannot enroll in these courses for 'credit only'.”

### Requirements for auditors (AU):

“Information about and requirements for auditing a course can be found at <http://policies.ncsu.edu/regulation/reg-02-20-04>”

**Policies on incomplete grades:**

“If an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://policies.ncsu.edu/regulation/reg-02-50-03>. Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.17.G at [<http://catalog.ncsu.edu/graduate/graduate-handbook/>]”.

**Late assignments:**

HWs and exams that are submitted past the deadline will tentatively incur a reduction of 5% for every 1-hour block past the deadline (except for an initial 10-minute grace period).

**Attendance and participation:**

As this is a completely asynchronous online course, physical and/or virtual attendance in meetings do not apply. However, one would be expected to view the recorded lectures, complete the HWs and exams, and contribute to the course participation Moodle forum.

Please give notification as soon as one is aware that one may be unable to submit an HW/exam due to illness or another reason, as this may impact the release of solutions or involve arranging for a make-up HW/exam.

Please see NC State’s Attendance Policy (<https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>) and Withdrawal Process (<https://studentservices.ncsu.edu/your-classes/withdrawal/process/>).

**Academic integrity:**

“Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct”. (A link is available at the end of page 5 below.)

It is expected that all HWs and take-home exams be completed individually without working together and without working with other individuals outside of the course. This also means that one should not seek direct or indirect assistance on an HW/exam through an online forum/message board, such as those provided by Chegg, Course Hero, Reddit, Quizlet, etc. It is expected that the Moodle course site not be used to specifically discuss the content of the course HWs and exams while such HWs/exams are being worked on by any course participants.

**Honor pledge:** “Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment.”” (One will see a similar statement when electronically submitting HWs/exams via the Moodle course site.)

**Digital course components: Moodle**

“Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.”

In addition to the course participation Moodle forum (graded), there will also be a general Moodle forum (optional, not graded). This optional forum is intended for initial introductions and general discussions with one’s fellow course participants during the semester (e.g., academic and career interests).

**Accommodations for disabilities:**

“Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, Campus Box 7509, 919-515-7653. For more information on NC State’s policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01) (<https://policies.ncsu.edu/regulation/reg-02-20-01/>).”

**Non-discrimination policy:**

“NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.”

**Additional NC State rules and regulations:**

“Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

Equal Opportunity and Non-Discrimination Policy Statement

<https://policies.ncsu.edu/policy/pol-04-25-05> with additional references at <https://oied.ncsu.edu/divweb/policies/>

Code of Student Conduct <https://policies.ncsu.edu/policy/pol-11-35-01>.”

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### **Information related to COVID-19:**

Please refer to NC State's Protect the Pack website (<https://www.ncsu.edu/coronavirus/>).

### **Information related to mental health and counseling:**

Please refer to NC State's Counseling Center website (<https://counseling.dasa.ncsu.edu/>).

### **Syllabus modification:**

This syllabus document may be revised, if needed. Any such changes will be announced, and the last modified date will be updated below.

**Note:** Some of the statements in this syllabus (e.g., policies) have been provided by NC State; such statements have been quoted above.

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**Date first uploaded:** 01/09/2024

**Date last modified:** -- (changes highlighted in gray)