

San José State University
Aviation and Technology Department
Tech 25: Introduction to Materials Technology, Spring 2018

Course and Contact Information

Instructor:	Dr. David P. Yan
Office:	IS 101
Office Phone:	(408) 924-3222
Email:	david.yan@sjsu.edu
Office Hours:	Wednesday: 10:00AM - 12:00 PM; (and by Arrangement)
Class Days & Time:	Tuesday/Thursday (Lecture, Section 01): 12:00 PM – 12:50 PM Thursday (Laboratory, Section 11): 1:30PM – 4:15 PM
Class Room:	E103 for lecture and E105 for lab activities

Lab: E-105 is not “open” lab and is not available except during the periods assigned to this class.

Prerequisites:	Math 008 or equivalent
Corequisites:	Chem 001A or 030A or equivalent

Course Description

Designed to introduce students to materials used to make consumer and commercial products. Including metals, plastics, and composites. How materials impact our lives and standard of living. Materials selection and the role of experimentation, testing and evaluation procedures.

Course Learning Outcomes

Students successfully completing Tech 25 should be able to:

- List the fundamental material types and describe chemical bonding, basic characteristics and applications of each.
- Describe the basic crystalline structure and both qualitatively and quantitatively estimate physical properties of crystalline materials.
- Describe point, linear, and planar defects in crystalline materials and how these effects on mechanical behavior.
- Estimate diffusion rates in solids in steady state operation.
- Quantitatively describe mechanical responses of materials to tensile and shear stresses and describe material properties such as hardness and toughness, as a result of responses to applied stresses.
- Describe different methods used in heat treatment of materials and what properties are altered by each method.
- Describe mechanisms for failure in materials, both fatigue and fracture, quantitatively characterize each as a function of defects, and describe ways to reduce failure.
- Analyze and apply phase diagrams for binary systems to characterize alloys and predict solid state microstructures.
- Describe different metal alloys and their properties and recommend the optimal material for specific applications.

- List the basic components of ceramics and characterize mechanical behavior of common ceramics.
- Describe basic polymer families, how polymers are formed, and resulting physical, chemical, and mechanical properties.
- Describe both particle reinforced and fiber reinforced composites, give application of both, and estimate physical properties based on fiber alignment.
- Describe mechanisms of corrosion, estimate corrosion rates, and describe corrosion prevention methods.
- Explain how semi-conductor materials are used to generate electricity.

Required Texts

Textbook

1. William D. Callister & David G. Rethwisch, "**Materials Science and Engineering: An Introduction**", 9th Edition, Wiley. ISBN: 978-1-118-32457-8 or Wiley Binder Version ISBN-13: 978-1-118-47770-0. Available at Spartan Book Store and at: https://www.amazon.com/Materials-Science-Engineering-William-Callister/dp/1118324579/ref=mt_hardcover?_encoding=UTF8&me=

Laboratory Handbook

The lab handouts are available on the **Canvas** (lab section). Please print the lab materials and read them thoroughly **BEFORE** each lab meeting.

Course Requirements

1. Assignments (20%)

Assignments will be given approximately bi weekly throughout the semester, and late assignments submissions will be accepted at the standard penalty of -20% per day late, cumulative.

2. Quizzes (10%)

Quizzes will be held randomly throughout the semester in both **lecture** and **lab** section and last for 30 minutes. These will not be announced beforehand. If missed, there is no makeup or recourse. Their objectives are to work problems regularly and reward lecture and lab attendance. No make-up will be given on any missed quiz.

3. Mid-Term Exam (15%)

One midterm exams of 50 minutes duration will be held on **March 22 from 12:00PM-12:50PM**, covering all the topics discussed in the class and previous assignments. More information will be provided about this exam.

4. Final Exam (30%)

The final exam will be scheduled by the university on **Thursday, May 17 from 9:45AM-12:00PM**. Also see the following links <http://info.sjsu.edu/static/catalog/final-exam-schedule-spring.html> The final exam will be comprehensive. More information will be provided about this exam.

5. Lab Activity and Report (15%)

Lab activities are an integral part of this course and include experiments, tutorials, demonstrations and workshops. Lab work will be done in group of 3 to 5 students and your active participation is required. See respective lab handouts for the description, parameters, and constraints for each lab.

A written lab report for each lab team will be due at the beginning of each lab period as detailed in the attached lab schedule. Only reports that are prepared on a word processor will be

accepted and late report submissions will be accepted at the standard penalty of -20% per day late, cumulative. For guidance in writing lab reports, consult the beginning material in the Laboratory Handbook. Also, SJSU has an excellent writing center. You can make an appointment to go over your lab report with a writing tutor. They also offer workshops and other resources to improve your writing. See the links: <http://www.sjsu.edu/writingcenter/>

The learning objectives you are responsible for on each lab are listed at the start of each Lab Notes chapter. These will be tested in the quizzes, midterm and final exams.

6. Term Project (10%)

Term project will be done in groups of 3 to 5 students, as much as possible from different majors. Each team should choose one topic from the list below. The purpose of the project is to give students an opportunity to study materials failure analysis in engineering disasters and experience in working in a team environment. The required aspects of the term project include:

- Materials failure analysis
- Oral communications
- Written communications

Project # / Title	Topic/Activity
1. Titanic disaster	Engineering design or materials failure analysis and the impact of engineering technology solutions in a societal and global context
2. Chernobyl disaster	Same as above
3. Space Shuttle Columbia disaster	Same as above

Students will be expected to dedicate 1 to 2 hours per week to the term project. To ensure timely progress in the project, there will be an oral term project review on **March 15** during the lab section. A final project presentation and a written report for each project team will be due at the end of the semester.

Students should prepare a final study report for selected term projects. You may copy some, or all, of the material you used for the oral term project review to include in this report. There is a 2000-word cap on the text in the report; there is no cap on the number of figures.

Part of the final project grade will be assigned to each student by that student's teammates. Therefore, students should submit an evaluation of their teammates' performance, based on participation and quality of work.

7. Policy on Exam, Assignment and Report Due Date: There are no makeup exams, assignments and reports or paper. The missed items are excused only with **written** documentation of unanticipated personal emergencies or by prior **written** permission of the instructor.

8. Participation in Class and Team Work: Team work and class participation are an integral part of the philosophy and learning. Your ability to participate in class, function as a team member, and to identify and carry out work as part of your team, will form a significant part of your grade. Anonymous peer evaluations are used to assist the instructor in validating problems in team performance. Take individual and team work seriously, and as part of the

curriculum. Always work to do more than your share, and communicate often, professionally, and effectively with your team mates.

Grading Information

Your grade will be based on your performances in the assignments, design projects, exams (mid-term & final), participation (in class & team), quizzes, and research paper.

Grading Schedule: The following items and percentages are used to determine your course grade:

Item	Number of items evaluated	Total Percentage
• Assignments	4	4x5=20
• Quizzes	2 to 5	10
• Mid-Term Exam	1	15
• Final Exam	1	30
• Lab Reports	3	3x5=15
• Term Project	1	10
Total		100

Determination of Grades:

A+ : $\geq 97\%$	A : $\geq 93\%$	A- : $\geq 90\%$
B+ : $\geq 87\%$	B : $\geq 83\%$	B- : $\geq 80\%$
C+ : $\geq 77\%$	C : $\geq 73\%$	C- : $\geq 70\%$
D+ : $\geq 67\%$	D : $\geq 63\%$	D- : $\geq 60\%$
F : < 60	(0.5 - 0.9) = 1	(0.1 - 0.4) = 0

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>

Tech 25: Introduction to Materials Technology, Spring 2018, Course Schedule
(Schedule subject to change with notice)

<u>Wk.</u>	<u>Date:</u>	<u>Topic (lecture content)</u>	<u>Recommended Readings and Assignments Due Dates</u>
	<i>Class meets</i>	<i>When there is no class specified, you are expected to be working on your assignments/lab reports and or term projects.</i>	<i>Assignments due as scheduled unless stated otherwise.</i>
1	Jan. 25 (Thursday)	<ul style="list-style-type: none"> • Discuss on course goals, logistics, grading, expectations, syllabus, term project etc. 	<p>All readings are from the required texts:</p> <ol style="list-style-type: none"> 1. William D. Callister & David G. Rethwisch, "Materials Science and Engineering: An Introduction", 9th Edition, Wiley 2. Outside Materials provided in class
2	Jan. 30 Feb. 1	<ul style="list-style-type: none"> • Atomic Structure & Interatomic Bonding • Structure of Crystalline Solids 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 2.1-2.4 & Ch. 2.6-2.9 • Textbook Ch. 3.1-3.10 & Ch. 3.12
3	Feb. 6 Feb. 8	<ul style="list-style-type: none"> • Crystalline and Noncrystalline Materials • Imperfections in Solids 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 3.13-3.15 & Ch. 3.17 • Textbook Ch. 4.1-4.4 & Ch. 4.6-4.8
4	Feb. 13 Feb. 15	<ul style="list-style-type: none"> • Diffusion • Mechanical Properties of Metals I 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 5.1-5.7 • Textbook Ch. 6.1-6.6 <p>• Assignment 1 Due</p>
5	Feb. 20 Feb. 22	<ul style="list-style-type: none"> • Mechanical Properties of Metals II • Dislocations & Strengthening Mechanisms I 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 6.7-6.12 • Textbook Ch. 4.5 & Ch. 7.1-7.4 & Ch. 7.6
6	Feb. 27 Mar. 1	<ul style="list-style-type: none"> • Dislocations & Strengthening Mechanisms II • Failure I 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 7.8-7.13 & Ch. 11.9 • Textbook Ch. 8.1-8.6 & Ch. 12.8 & Ch. 15.5
7	Mar. 6 Mar. 8	<ul style="list-style-type: none"> • Failure II • Phase Diagrams I 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 8.7-8.15 & Ch. 15.4 • Textbook Ch. 9.1-9.4 & Ch. 9.6-9.11 <p>• Assignment 2 Due</p>
8	Mar. 13 Mar. 15	<ul style="list-style-type: none"> • Phase Diagrams II • Phase Transformation I 	<p>Read:</p> <ul style="list-style-type: none"> • Textbook Ch. 9.13-9.15 & Ch. 9.18-9.19 • Textbook Ch. 10.1-10.6

9	Mar. 20	• Review for Midterm Exam	• Attendance mandatory
	Mar. 22	• Midterm Exam	
10	Mar. 27 Mar. 29	SPRING BREAK (NO CLASSES)	SPRING BREAK
11	Apr. 3	• Phase Transformation II	Read: • Textbook Ch. 10.7-10.9 & Ch. 12.11 • Textbook Ch. 11.1-11.3
	Apr. 5	• Application and Processing of Metal I	
12	Apr. 10	• Application and Processing of Metal II	Read: • Textbook Ch. 11. 7-11.9 • Textbook Ch. 12.1-12.2 & Ch.12.5-12.6 & Ch. 12.9 • Assignment 3 Due
	Apr. 12	• Structure and Properties of Ceramics	
13	Apr. 17	• Application and Processing of Ceramics	Read: • Textbook Ch. 13. 1-13.9 • Textbook Ch. 14.1-14.7 & Ch.14.9-14.14
	Apr. 19	• Polymer Structure	
14	Apr. 24	• Characteristics, Application, and Processing of Polymer	Read: • Textbook Ch. 15.1-15.3 & Ch. 15.7-15.9 & Ch. 15.15-15.19 • Textbook Ch. 16.1-16.3 & Ch.16.9 & Ch. 16.13
	Apr. 26	• Composites	
15	May 1	• Corrosion and Degradation of Materials	Read: • Textbook Ch. 17.1-17.3 & Ch.17.5-17.13 • Textbook Ch. 18.1–18.15 • Assignment 4 Due
	May 3	• Electrical Properties	
16	May 8	• <i>Last Day of Instruction is May 14</i>	• Attendance mandatory
	May 10	• Review for Final Exam	
17	May 17	Final exam is Thursday, May 17	9:45AM-12:00PM

Tech 25: Introduction to Materials Technology, Spring 2018, Laboratory Schedule
(Schedule subject to change with notice)

Wk.	Date:	Topic (lecture content)	Recommended Readings and Assignments Due Dates
	<i>Class meets</i>	<i>When there is no class specified, you are expected to be working on your assignments/lab reports and or term projects.</i>	<i>Assignments due as scheduled unless stated otherwise.</i>
1	Jan. 25 (Thursday)	<ul style="list-style-type: none"> • Orientation to the class • Discuss on lab safety, goals, logistics, grading, syllabus, term project etc. 	All readings are from the required texts: 1. Laboratory Handbook 2. Textbook- Callister & Rethwisch, "Materials Science and Engineering: An Introduction", 9th Ed
2	Feb. 1	Lab 1: <ul style="list-style-type: none"> • Term Project • Crystal Structure Introduction 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 1
3	Feb. 8	Lab 2: <ul style="list-style-type: none"> • Crystal Structure I- Basic Crystal Structures • Worksheet & Report 1 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 1 • Textbook Ch. 3.1-3.7
4	Feb. 15	Lab 3: <ul style="list-style-type: none"> • Crystal Structure II- Planes, Directions, & Defects • Worksheet & Report 1 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 2 • Textbook Ch. 3.8-3.10
5	Feb. 22	Lab 4: <ul style="list-style-type: none"> • Crystal Structure III- Tensile & Fracture Tests • Worksheet & Report 1 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 3 • Textbook Ch. 3.11-3.12 <ul style="list-style-type: none"> • Report 1 Due
6	Mar. 1	Lab 5: <ul style="list-style-type: none"> • Cold Working of Brass • Worksheet & Report 2 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 5 • Textbook Ch. 6.7 & Ch. 7.10
7	Mar. 8	Lab 6: <ul style="list-style-type: none"> • Phase Diagram and Cooling Curves • Worksheet & Report 2 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 6 • Textbook Ch. 9 <ul style="list-style-type: none"> • Report 2 Due
8	Mar. 15	<ul style="list-style-type: none"> • Oral Term Project Review 	<ul style="list-style-type: none"> • Outside materials
9	Mar. 22	Lab 7: <ul style="list-style-type: none"> • Steel Processing I-Processing and Microstructure • Worksheet & Report 3 	Read: <ul style="list-style-type: none"> • Lab Handbook Ch. 7 • Textbook Ch. 9.18-9.20
10	Mar. 29	<ul style="list-style-type: none"> • SPRING BREAK (NO CLASSES) 	SPRING BREAK

11	Apr. 5	Lab 8: • Steel Processing II -Metallographic Examination • Worksheet & Report 3	Read: • Lab Handbook Ch. 8 • Textbook Ch. 10
12	Apr. 12	Lab 9: • Corrosion: The Galvanic Series • Worksheet & Report 3	Read: • Lab Handbook Ch. 4 • Textbook Ch. 17.1-17.3, 17.5-17.13 • Report 3 Due
13	Apr. 19	Lab 10: • Temperature Dependence of Conductivity in Metals and Semiconductors • Worksheet	Read: • Lab Handbook Ch. 10 • Textbook Ch. 18.1 – 18.15
14	Apr. 26	Lab 11: • Product Life Cycle Analysis • Worksheet	Read: • Lab Handbook Ch. 11 • Textbook Ch. 22
15	May 3	• Term Project Presentation	• Attendance mandatory
16	May 10	• Last Day of Instruction is May 14 • Review for Final Exam • Lab Clean-Up	• Attendance mandatory

THIS SCHEDULE IS SUBJECT TO CHANGE DEPENDING ON CIRCUMSTANCES DURING THE SEMESTER

Posted Dates are Thursdays Unless Specified.

All Assignments are Due on Thursdays Unless Changed by Instructor.

March 26 - March 30 is Spring Recess (Campus Closed)

Friday, March 30 is Cesar Chavez Day (Campus Closed)