EGR 218: Materials and Manufacturing Processes, Fall 2021 Session

3 Credit Hours

Faculty Information	Instructor: Prof. Kenan Song Office: Tech Center 151 Phone: 480-727-2720
Class Time and Location	Days: Tuesdays and Thursdays 1:30 – 2:45PM Duration: 08/19/2021-12/03/2021 Location: Poly AGBC 134
Websites	Canvas: https://asu.instructure.com/courses/96593 Workspace URL: asu-2217-egr218-74666.slack.com
Office Hours	Tuesdays (2:50pm to 3:30pm); strongly recommend a pre-arranged appointment; the SLACK channel is the best way for QA
Textbook	**Manufacturing Engineering and Technology, 7th ed., Kalpakjian and Schmid**
Reference Works On reserve at the Center Library	Fundamentals of Modern Manufacturing, 3rd ed., M.P. Groover Binary Alloy Phase Diagrams, Massalski, editor (online access)
Other useful references	Physical Metallurgy Principles, Reed-Hill (any edition) Structure and Properties of Alloys: The Application of Phase Diagrams to the Interpretation and Control of Industrial Alloy Structures, Brick CRC Handbook of Chemistry and Physics, any edition Thermophysical Properties of Matter (Only at the Noble library reference section)
Relevant Software	MS-Word, PowerPoint, Excel
Course Website	myasucourses.asu.edu (CANVAS)
Prerequisites	CHM 113, or CHM 114

EGR 218 - Materials and Manufacturing Processes

Course Description

Applies material properties and manufacturing processes to the design and fabrication of engineered artifacts.

Enrollment requirements

Prerequisite(s): CHM 113 or 114 with C or better OR Visiting University Student

Offered by

Ira A. Fulton Schools of Engineering

Additional Class Details

General Studies: No
Component: Integrated Lecture/Lab
Units: 3
Repeatable for credit: No

Important Deadlines

Last day to enroll: August 25, 2021
Drop deadline: August 25, 2021
Course withdrawal deadline: November 03, 2021

Fall 2021 | Class # 74666

Seats Open: 0 of 79 ✖
Fees: None

Days	Dates	Start	End	Location	Instructor
T Th	08/19 - 12/03	1:30 PM	2:45 PM	Poly - AGBC154	Song

Add Class

Course Materials

Not yet provided by instructor. Refer to syllabus for additional details.

Catalog Description of EGR 218:
Applies material properties and manufacturing processes to the design and fabrication of engineered artifacts.
Course Objectives:

Materials Classification	Students are able to identify materials of different types and identify the general differences between materials of different types
Materials Selection	Students are able to use Ashby plots and similar to select an appropriate material for a specific design constraint
Materials Properties	Students are able to identify what dictates material properties and identify processes that can alter material properties
Mechanics of Materials	Students are able to conduct basic materials mechanics analysis related to diffusion, stress & strain, heat treatments
Understand Basics of Manufacturing Processes	Students are able to distinguish between various manufacturing processes and describe the working principles of each process
Manufacturing Process Selection	Students are able to select appropriate manufacturing processes for a specific material and design

Course Grading:

Homework:	20 percent	(4 assignments for take home, 5 points each)
Mid-term Exam- via zoom:	30 percent	(30 point exam, on zoom and video on)
Final Exam - via zoom:	20 percent	(20 point exam, on zoom and video on)
Manufacturability Project:	10 percent	(10 point team assignment)
In-class participation:	20 percent	(Pop quizzes, all online via zoom and all on Thursdays)
	100 percent	

Grading Scale (based on the total percentage accumulated): I will curve grades as appropriate

- 100-90 = (A+ will be given for 95+)/ A for <95
- 89-80 = B+ for 85+/ B for <85
- 79-70 = C+ for 75+/ C for <75
- 69-60 = D
- 59 or below = E

Grade Adjustments. If you believe that there was a grading error, and you have written a justification, please bring the graded assignment to your instructor for discussion. Questions or concerns about grading should be presented in a professional manner.

Homework:

- 4 homework assignments, 5 points each.
- Assignments will be posted on the course CANVAS site, in the weeks noted on the class calendar.
- Your homework will be due on the following THURSDAY, **ONLINE.** Homework may be handed-in up to one week late- but will receive an automatic 50% penalty.
- Homework will **NOT** be accepted after one week; a "zero" score will be given for missed homework.
- Makeup homework- only with a *really* persuasive reason.
- We will use the MKS, or "Systeme Internationale" units, *NOT* cgs or US or English measurements.
- All numeric answers in the homework and exams should be presented in standard SI notation, and SI units (meter, kilogram, second, etc.), with the **correct number of significant digits.**
- **Tutoring is available in the Tutoring Center, above the library, northeast side.**

Exams:

- There will be 2 exams, see table below. The final exam will cover the full semester.
- The exams may consist of True/False, short answers, quantitative problems, materials/manufacturing process selection and justification questions.
- You will certify that you did the exams without assistance from other students.
- Makeup exams will be given with a written medical excuse only. No makeup for the final exam.

Manufacturing Team Project: Students will be suggested in groups of 10-15, with each group ~5-8 students.

- Each student group will carry out a "manufacturability case study" on an ***existing commercial product*** of their choice.
- One student will be selected by the group members as the "project leader".
- The product must have **at least 5 unique components**, not counting assembly parts (screws, rivets, fasteners, clips or bolts). Suggestion - do not opt for an overly complex product!

- "Reverse Engineer" your product to the component/sub-assembly level.
- Examples are provided to help guide your developments.
- Textbook Chapters 10-27 can help identify methods and processes. These topics will be addressed in detail in the latter half of the class sequence.
- Find the average selling price for the product in the marketplace- note that this may entail checking several sources- full-price retailers versus cost-cutters versus "overstock" shops.

Students will divide the project activities to cover the following areas and document relevant results from these activities in the final report:

1. Select a commercial product. The product must have at least 5 unique components (not counting fasteners, clips, screws, bolts, etc.)

2. "Reverse Engineer" your product to the component level. List the materials of construction for your product.

- Explain why you think these materials were selected by the manufacturer (e.g., cost, ease of manufacture or assembly, ease of shaping, strength, stability, weather resistance, wear resistance, maintenance/repair, etc.).

*Make an Excel table, "Components", listing each component, material, coating or plating, OEM reasons for selection, and the fasteners used (**NOT** in the parts count…)*

3. List all of the manufacturing methods and tools/processes necessary to create the product.

- For each component, consider the possible methods for producing the part, and the associated tools or equipment (there may be several options for each component).
- For each component, consider the possible methods and tooling for coating/plating/protecting the part in its intended use or application (there may be several options for each component).

Make an Excel table, "Manufacturing Methods", listing each part, part descriptions and materials, and all of the manufacturing processes needed to make each part, and reasons for selection of the process step or tooling/equipment.

4. Create a complete process flow sequence for each component in your product.

*Make an Excel table, "Process Flows", for each part and material, and coating processes. Describe **all** of the process steps needed for each component.*

5. Create a complete listing of ALTERNATE materials, processes, tools and flow sequence for each component in your product.

Make an Excel table, "Alternate Matls and Processes", for each part and material, and coating processes. For each component document your reasoning and trade-offs

6. **Create a complete assembly sequence for your product**. Consider series, parallel and series/parallel assembly flows. Comment on the speed of assembly (your estimates, units per unit time) using different flows and manufacturing methods.

The Project will be graded based on:

- Team member's contributions– each student is responsible for working on at least one item (1-6) in the above list. Note that group efforts will be most effective for each item, but one person takes the "lead" as the expert in the topic.
- The team leader must submit a file through CANVAS in your group files area that includes the names of the team members, the NAME OF THE TEAM, the selected product, and each individual's responsibility. 5% of the project score, **due date see the timeline table from page 6**.
- A mid-semester **5-minute** progress report presentation- the team leader will provide a **1 minute** PowerPoint overview, and each team member will give a short PowerPoint summary of their activities- 1 minutes each maximum, covering items 1-3. 25% of the project score. **To be presented and critiqued (due date see the timeline table from page 6)**. The presentation file will be placed in the CANVAS group file site by the end of the day, **due date see the timeline table from page 6**.
- The FINAL project presentation will follow the same procedure– the team has **5 minutes** for presentation. The team leader will provide a **1 minute** PowerPoint overview, and each team member will give a short PowerPoint summary of their activities- 1 minutes each maximum. 50% of project score, **to be presented and critiqued (due date see the timeline table from page 6)**. The final presentation must include the results of items 4 through 6, as noted above. The presentation file will be placed in the CANVAS site by the end of the day, **due date see the timeline table from page 6**.

- One project final report per team, 20% of the project score, **due date see the timeline table from page 6, to be submitted through CANVAS by the team leader and each member of the team. The report must include the Project Title, the team member's names, the team member's "area of expertise" in the project, the product analyses documentation, supporting data, assumptions for each major topic or item in the list above, your conclusions about the manufacturing of your product, the cost, and answer the question: "Could we bring this product to market"- your opinions, not just yes or no.**

Expectations for EGR 218 Students:

- You must submit your own individual work for all assignments and the exams. The only exception is the team manufacturability project.
- ***Academic dishonesty in any form, cheating, plagiarism, copying, etc., will result in a grade of E.***
- **Attend class.** The presentation and discussions in class cover topics in-depth and scope beyond the textbook. This is a vital part of understanding the materials in the course. Many illustrative sidebars and other information will be presented. Pop quizzes will be given from time to time.
- **Read the class textbook.** Reading the assigned materials will greatly help you understand the topics discussed in class. Investigate other resources, the libraries, and reference works.
- **TAKE NOTES-** experience showed this was important! Use of your laptops for taking notes or for class activities is permitted. ***However, Facebook, Twitter, email, texting, video games, web surfing, etc., are NOT appropriate class time activities.***
- **Participate in class**. Come prepared to learn, actively participate in individual and group activities and discussions. Ask questions at any time.
- **Internet-** we found that Google searches are not very effective. Use Yahoo! ;) The internet provides an easy method to find information, but the veracity and accuracy are not always confirmed; *be careful!*
- **Actively participate** as a team member on the team project.
- **Study and preparation time-** you should plan on spending 2 to 3 hours per week outside of class for each course credit hour (i.e., 6 to 9 hours per week for this class) to get the most out of this course. If something is interfering with your success in this course, please see me as soon as possible. I am happy to help you with any questions or problem areas.
- **Absences** will only be accepted in the following circumstances:
- Prior notification to the instructor, and with the instructor's written approval. Email is appropriate.
- Documented illness, injury or other reasonable, valid emergency, and with the approval of the instructor.
- Absences due to religious observances/practices (in accord with ACD 304–04, "Accommodation for Religious Practices"), or, as related to university-sanctioned events or activities (in accord with ACD 304–02, "Missed Classes Due to University-Sanctioned Activities") will be accommodated. At least one week advance notice to the professor is required.
- **Check your ASU email often.** I will communicate with you at your ASU email address. You are expected to be aware of these communications. I expect all email communication to be done in a professional manner. Use an appropriate subject line description, an appropriate greeting, professional language, tone and correct grammar, and sign your name. These guidelines pertain to all homework assignments and in-class presentations, in-class discussions, and ASU e-mail correspondence.
- **Check your CANVAS and SLACK every day!**
- Other Important Information:

Students with disabilities- The Americans with Disabilities Act (ADA) provides comprehensive civil rights protection for persons with disabilities. This legislation requires that all qualified students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation please contact the Disability Resource Center at ASU Polytechnic located in Sutton Hall, Suite 240, or call 480-727-1039 / TTY: 480-727-1009. Policies regarding eligibility and documentation are available online at: http://www.asu.edu/studentaffairs/ed/drc/ . Any students who have special needs or accommodations for this course are encouraged to communicate with me as soon as possible to make appropriate arrangements.

Sexual Discrimination- Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling is available if you wish to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, https://goto.asuonline.asu.edu/success/online-resources.html.

The ASU Face Cover Policy (https://www.asu.edu/about/fall-2021#face-coverings) requires the wearing of face covers in the majority of classrooms, teaching laboratories, studios and workshop settings. The space for this class has been designated as a space requiring face covers. Please wear a face covering over your nose and mouth at all times during class for the health and safety of yourself and others.

On-Campus Resources:
There are many resources on campus to help you achieve personal and academic success:

- Writing centers – http://studentsuccess.asu.edu/writingcenters
- Tutoring, student success centers: http://studentsuccess.asu.edu
- Counseling / consultation: http://students.asu.edu/counselingpoly
- Career preparation center: http://students.asu.edu/career/poly
- Libraries: http://libguides.asu.edu

Academic Conduct & Responsibility:

- Each student has an obligation to act with honesty and integrity, and to respect the rights of others in carrying out all academic assignments. In EGR 218, **any student who is found to have violated the academic integrity policy will, as a minimum, receive an E in the course**.

Policies:

- Academic Integrity Policy: https://provost.asu.edu/academicintegrity/students
- Students are expected to execute all course assignments and activities in accordance with the University's Student Academic Integrity Policy. Detailed information on the policy can be found at https://provost.asu.edu/index.php?q=academicintegrity
- Student Code of Conduct: https://students.asu.edu/srr , http://www.asu.edu/studentlife/judicial/

Students are expected to participate in the educational process and not be a disruptive element with regard to the learning of others. Safety, self-discipline and respect for others are necessary elements in the educational processes employed in this course.

Class Week	Date	Lectures- subject to class progress	HW Given (Tuesdays)	HW & Pop quiz Due (Thursdays)	Project/Exams
0	Aug 19	The instructor will solve technical issues and the students will get themselves familiar with the syllabus			
1 Lec 1, 2	Aug 24 & 26	Pre-requisite: Read Introduction, Chapters 1, 3 in Kalpakjian & Schmid Instructor introduction Review the course syllabus and expectations Discussion of the Manufacturability Project and Teams Introduction to Materials and Manufacturing and States of Matter, Basic Properties		Pop quiz	**Discuss the team project**
2 Lec 2, 3p1, 3p2	Aug 31 & Sep 2	READING- Chapter 3 Introduction to Materials and Manufacturing and States of Matter-2 The Periodic Table, Atomic Structure and Bonding Bonding and Crystal Structure	HW1	Pop quiz	**Team project written proposal for advice due**
3 Lec 4, 5, 6p1	Sep 7 & 9	READING- review Chapter 3 Bravais' lattices, and Miller Indices Thermodynamic concepts Defects in materials, diffusion, kinetics		HW1 Pop quiz	
4 Lec 6p1, 6p2, 7p1	Sep 14 & 16	READING- Chapters 4, 5 Review HW1 Defects in materials, diffusion, kinetics-2 Mechanical properties of materials: grain structure, defects, dislocations Impurity effects; strengthening methods and processes Classes of materials: iron and steel	HW2	Pop quiz	
5 Lec 7p1, 7p2	Sep 21 & 23	READING- Chapters 2, 4, 6, 8 Classes of materials: iron and steel-2 Classes of materials: non-ferrous metals		HW2 Pop quiz	
6 Lec 7p3, 7p4	Sep 28 & 30	READING Chapters 8, 7 Review HW2 Classes of materials: ceramics Classes of materials: glasses		Pop quiz	
7	Oct 5 & 7	First Project presentations- 5 minutes for each team- be prepared, keep to schedule!		Pop quiz	**Team Oral Presentations**
8 Lec 7p5, 7p6	Oct 12 & 14	READING Chapters 7, 9 Review HW3 Classes of materials: carbon and polymers Classes of materials: composites	**Mid-term Exam**	Pop quiz	

9 **Lec 7p7, 8, 9p1**	Oct 19 & 21	READING- Chapter 28 Classes of materials: semiconductors Ashby plots and Materials Selection Machining processes	HW3	Pop quiz	
10 **Lec 9p1, 9p2, 10**	Oct 26 & 28	READING- Chapter 21, 22, 23, 24, 26 Machining Processes-2 Surface treatments and preparation methods Grinding, polishing, laser hardening, ablation		HW3 Pop quiz	
11 **Lec 11, 12**	Nov 2 & 4	READING- Chapter 12, 17 Casting- bulk and shaped forms Molding techniques, powder metallurgy Forming methods		Pop quiz	
12 **Lec 13, 14**	Nov 9 & 11	READING- Chapter 20, 30, 31, 32 Review HW4 Rapid prototyping (RP) methods, 3D model making Joining processes: soldering, brazing, welding, adhesives and fasteners **Nov 11 - - no class due to the Veteran's Day**	HW4	Pop quiz	
13 **Lec 15, 16**	Nov 16 & 18	READING- Chapter 37, 40 Design for Manufacturability and Automation Design-to-cost approaches and constraints		HW4 Pop quiz	**Team Oral Presentations (Nov 18 &23)**
14	Nov 23 & 25	Final Project presentations - 5 minutes each team- keep to schedule! Part of the Lec17 if time allowed on 23rd. **Nov 25 - - no class due to the Thanksgiving**		Pop quiz	**Team Oral Presentations (Nov 18 &23)**
15 **Lec 17, 18**	Nov 30 & Dec 2	READING- Chapter 34 Review HW5 Coating materials and methods: powder coating, anodizing, nitriding, ceramic fusion/plasma Samurai sword making		Pop quiz	**Final project Report due online**
16	Dec 6 & 11	Final Exam week & Final grades posted Dec 13th, 2021	**Final exam**		

Notice:

- Tuesday class will be in the classroom for QAs
- Thursday class will be on zoom (**https://asu.zoom.us/j/5013591559**) for pop quiz (total points of 20 points and you should pay close attention to the zoom lectures)
- All HWs will be posted/assigned online and only online submissions are acceptable (makeup will be exceptions).
- Students registered with the ASU Disability Resource Center (DRC) will be given extra time (please also discuss this with the instructor) and listed in a separate slack channel.