MAT E 201
MATERIALS SCIENCE

The course

1. Introduction Chapter 1

2. Structure of solids Chapter 2

- Atomic and Electronic Structure
- Bonding
- Periodic Table

3. Atomic and Ionic Arrangements Chapter 3

4. Imperfections in the Atomic and Ionic Arrangements Chapter 4

5. Atom and Ion Movements in Materials Chapter 5

6. Solid Solutions and Phase Diagrams Chapter 10

7. Dispersion Strengthening and Eutectic Phase Diagrams Chapter 11

8. Ceramic Materials Chapter 15

9. Polymers Chapter 16

Midterm

10. Composite Materials Chapter 17

11. Electronic Properties of Materials Chapter 19

12. Magnetic Properties of Materials Chapter 20

13. Photonic Properties of Materials Chapter 21

14. Applications

Final

The science and engineering of Materials, D.R. Askeland, P.P. Fulay, W.J. Wright, 6th or 7th edition, Cengage learning, 2011

Materials Science and Engineering: An Introduction, 8th, by William D. Callister, Jr., David G. Rethwisch, 8th Edition, ISBN-13: 978-0-470-41997-7, John Wiley & Sons, 2010.

The grading

Assignments	**Approximately weekly**	**25%**
Mid-term exam	Tentative, Friday, November 5th, 2021	30%
Final exam	TBA, December 2021	45%
Total		100%

Assignments will be approximately on a weekly basis. Assignments should be submitted on PDF (**LastName_FirstName_AssignmentNumber.pdf**) by 3:00 PM on the day they are due. Any late assignments will be subject to a penalty of 20% for the first 24 hours and will not be accepted after 24 hours.

Mid-term exam A 1 hour online exam. The Procedure to solve the questions must be uploaded at the end of the exam.

The Final exam will be a 24 hour study case exam. The students will have 24 hours to solve a case study question exam which will require for the students to analyze, apply knowledge, reason and draw of conclusions The topics that will be evaluated are composite, electronic, magnetic, photonic materials and applications.

The team

- Lecturer:

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Sessional Professor

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- Graders:

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You might hear me barking or going crazy in the background **Sorry!**

Introduction to Materials Science & Engineering

- **Course Objective:** Introduce fundamental concepts in Materials Science
- **You will learn about**
  material structure
  how structure dictates properties
  how processing can change structure

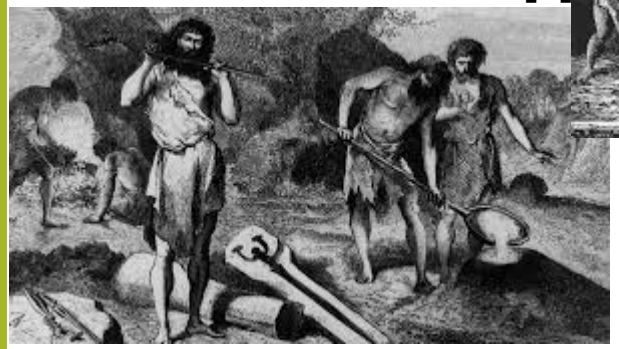
However…

This course is designed to give non- material or chemical engineers the basics about material science and smart material design

Why Material Science?

[1]

Historically, the development and advancement of societies have been intimately tied to the members' ability to produce and manipulate materials to fill their needs.



[2]

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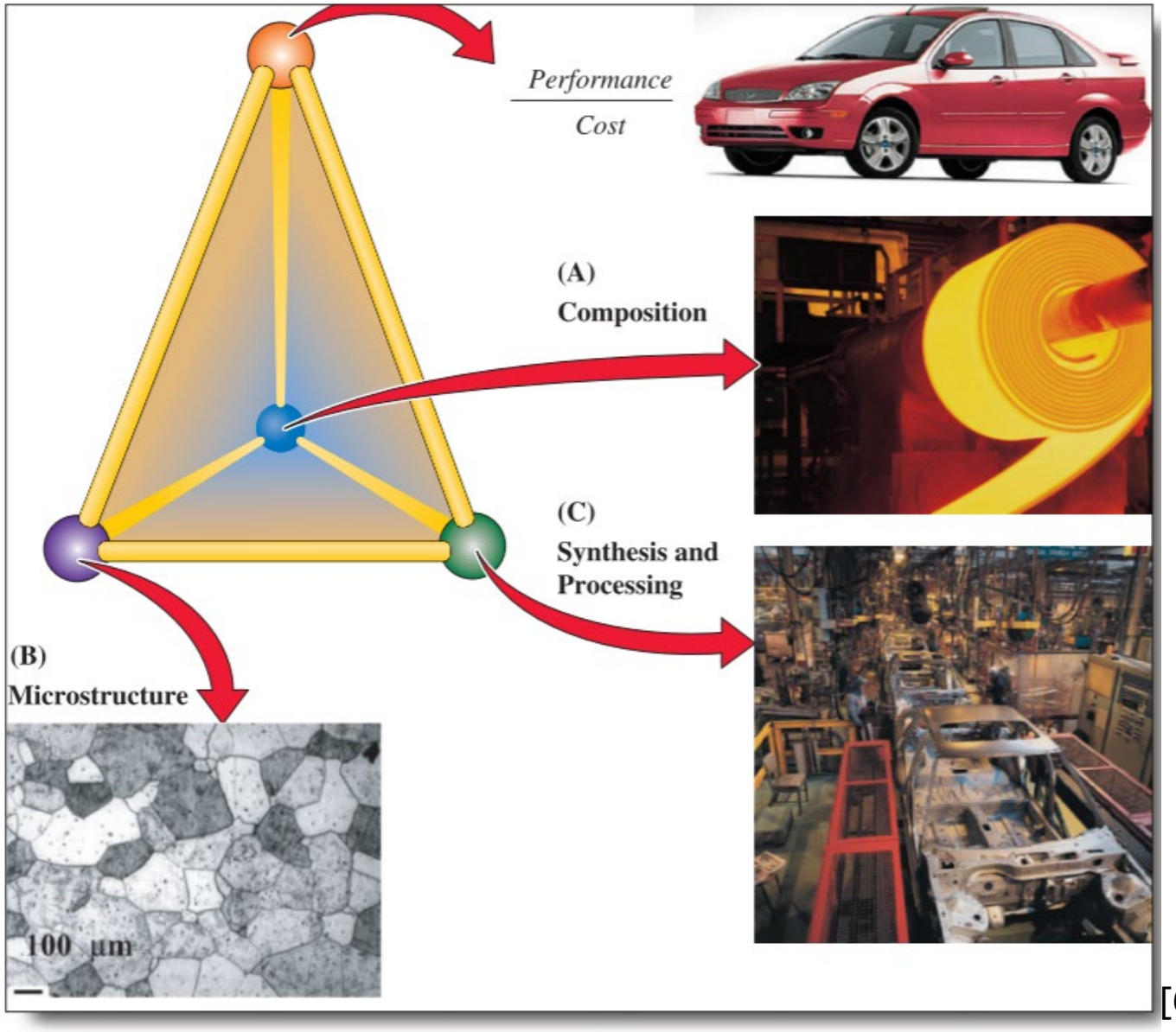
Why Material Science?

- Make existing materials better
- Invent or discover new phenomena, materials, devices, and applications.



[6]

Basic concepts

- **Composition:** The chemical make-up of a material.
- **Structure:** The arrangement of its internal components. *Subatomic structure* involves electrons within the individual atoms and interactions with their nuclei. *Microstructure and Macrostructure*
- **Property**: A material trait in terms of the kind and magnitude of response to a specific imposed stimulus (Independent of the shape and size of the material).
- **Synthesis**: Process to create or make a material, either by natural occurrence or man-made.
- **Processing**: Process of manipulating materials to obtain certain properties for desired applications.

Material Simple analysis

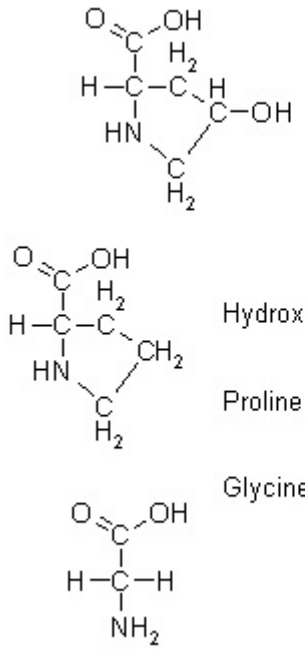
What is the make-up?

Composition:
Sugar, Gelatin, Adipic Acid, Artificial Flavor, Disodium Phosphate and Sodium Citrate, Fumaric Acid, Red 40.

How is the internal arrangement?

Structure:
Main component:
Gelatin -Collagen .

[7]



[8]

Processing:
Add water to get the result wanted

[9]

How is it made?

Synthesis:
Dissolve the collagen to convert it into Gelatin with strong acids. Further chilling, cut and drying in a special chamber.

Material Selection process

1. Application — What **properties** do I need for this application?

   Properties: mechanical, electrical, thermal, magnetic, optical, deteriorative

2. Properties — What **material** has these properties?

   Material: structure, composition

3. Material — Does this material require **processing** for the application desired?

   Processing: changes *structure* and overall *shape* ex: casting, sintering, vapor deposition, doping, forming, joining, annealing.

Classification according to function

- **Aerospace** Aluminum alloys, plastics and silica for space shuttle tiles, among others.
- **Biomedical** Plastics, titanium alloys, and nonmagnetic stainless steels.
- **Electronic Materials** Barium titanate ($BaTiO_3$), tantalum oxide (Ta_2O_5), and many other dielectric materials; Copper, aluminum, and other metals.
- **Energy Technology and Environmental Technology Z**irconia (ZrO_2) and polymers. zeolites, alumina, and other materials as catalyst substrates. ceramics and plastics.
- **Magnetic Materials A**lloys based on cobalt-platinum-tantalum-chromium (Co-Pt-Ta-Cr) alloys. Steels based on iron and silicon.
- **Photonic or Optical Materials** Silica ,alumina (Al_2O_3) and yttrium aluminum garnets (YAG) , and polymers.

References

The science and engineering of Materials, D.R. Askeland, P.P. Fulay, W.J. Wright, 6th edition, Cengage learning, 2011

Materials Science and Engineering: An Introduction, by William D. Callister, Jr.,David G. Rethwisch, 8th Edition, John Wiley & Sons,2010.

[1,2 & 3] https://www.history.com/topics/pre-history

[4] https://deadline.com/2019/08/silicon-valley-return-sixth-final-season-october-1202652950/

[5] https://www.today.com/health/plastic-face-mask-are-face-shields-better-masks-t179641

[6] D.R. Askeland (6th Edition). Figure 1-1

[7] https://www.dreamstime.com/red-jelly-jello-powder-red-jelly-jello-powder-small-bowl-prepared-jelly-dessert-spoon-back-photographed-image121001492

[8] https://proteopedia.org/wiki/index.php/Collagen_Structure_%26_Function

[9] https://nypost.com/2018/08/07/the-messy-family-history-behind-the-jell-o-empire/