

MEEN 3344 Material Science

EXAM 2 REVIEW SHEET Fall 2008

- Exam will start at 7:30 am, I may come earlier if possible.
- 16/27 wanted online quiz, 11/27 did not want.
- Chapters 8, 9, 10, 13 & 14 are the chapters you feel know best.
- Chapters 10, 13, & 14 are the ones you feel that you know the least.
- If I can't make the online exam work right I will make a paper only exam.

CLOSED BOOK

- You will be allowed your brain, a calculator and a pencil or pen.
- **You can bring one 5x7 card, handwritten notes only, on both sides, no sheets of paper.**

Online Portion

- You will be allowed your brain, a calculator and a pencil or pen.
- You can use only the online text, and the card below. Time is critical, spend no more than 40 minutes on it, if you come early.

- You must show all your work on the exam to get full credit.
- If you are caught copying from some else's exam, or knowing let someone copy from your exam, or if you work with someone else on the exam, you will be dropped from the course or given an F.
- Budget a certain amount of time per problem, if you do not finish it, go on to the next problem.

Material to be covered:

- Ch. 8 Know and be able to discuss the types of dislocations and strengthening mechanisms. Know what a slip system is, and know what solid solution hardening, strain hardening are.
- Ch. 9 Understand and be able to discuss the types of failure, including yielding, brittle fracture, impact, fatigue, creep, and temperature effects.
- Ch. 10 & 11 Understand basic binary phases. Be able to use the lever rule. Be familiar with such terms as equilibrium, eutectic, etc. Know the Iron-carbon phase diagram for steel and cast iron. Know kinetics and Microstructure of structural transformations (heat treating). Understand the non-equilibrium phase transformations, such as quenching, hardening, solution heat treating, aging, diffusion, know the TTT (IT) graphs and be able to use them.
- Ch. 13 & 14 Know and be able to discuss, and calculate parameters relating to the heat treating of metal alloys, including annealing, stress relief, martensitic hardening, and PH hardening. Know and be able to discuss the other structural metals, including aluminum, copper and it's alloys, titanium, the refractory metals, zinc, magnesium, and other minor metals. Know their uses advantages, and disadvantages.

Know the common definitions from each chapter.

Sample Questions

1. What are the most common types of crystal defects and how do they affect properties?
2. What are four types of hardening or strengthening? How are they related?
3. What are 6 types of failure? How are they inter-related? How are ductility and brittleness related?
4. Of the FE Exam review questions (on web page), which are relevant? Do you know their answers?
5. What factors affect fatigue, fracture, what is a failure?
6. What characteristic does copper/beryllium, PH stainless steels, and many alloys of aluminum have in common?
7. Compare the martensitic and PH hardening methods. Name the advantages of each. Can both be done on the same material?
8. Compare the stiffness' of steel, cast iron, aluminum alloy, and copper alloy groups. Why is there greater variation in some groups and less in others. Which group has the least variation. Why?
9. What is the basic purpose of TTT/IT charts? Give the heat treatment for a 4130 steel with half bainite and half martensite. What is tempered martensite?
10. Why is aluminum so heavily used in commercial aircraft? What can be done to improve the strength of aluminum? What problems does this bring on?
11. What aluminum properties are constantly being improved by the aircraft industry?
12. Given a phase diagram, calculate the percentages of each of two phases, given the percentage of each element and a temperature.
13. Discuss the Jominy end-quench test, and discuss it's usefulness.

14. What is the density of the major groups of metals? Does alloying affect these densities greatly? Why or why not?
15. You are requested to design a system for irrigating a field. What would you make it out of?
16. What are the major uses for copper, titanium, gold, silver, Tungsten, Hafnium, aluminum, etc?
17. What are the noble metals? What are the refractory metals?
18. Why are the refractory metals so strong, stiff, heavy, etc? How does this correspond with their melting temperatures? How is this related to atomic bonds strengths as discussed in Chapter 2?
19. Given an aerospace structure, such as a satellite, discuss 3 materials that it could be made out of, and discuss the relative merits of each.
20. What is a simple test to determine the relative machinability of 3 metals? (Scratching) What is the difference between welding, brazing, and soldering?
21. What are the basic differences between hot and cold-rolled steels? When would you want a cold rolled steel? When would you want a hot-rolled steel?
22. Name 4 types of failure. Discuss how they could be prevented.

***** Look heavily at the FE Exam Review Questions ***