Department of Mechanical Engineering
University of California, Berkeley

ME 122 – Processing of Materials in Manufacturing

Course information
Spring 2015

Prof. Hayden Taylor (hkt@berkeley.edu)
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Welcome

Welcome to Mechanical Engineering 122. The central objective of this course is to help you understand the relationship between the choice of *material* and the choice of *processing route* that is essential when planning the manufacture of mechanical components.

This is the first time that this staff has taught this class, and we are experimenting with a brand new format for the project this semester. To help make this new format a success, we encourage you to send us your thoughts, comments and suggestions about the class regularly. You can make suggestions by e-mail, in office hours, or by sending the instructors a message through bCourses. Taking the time to tell us what we can do to improve will help enhance your experience, and also that of students who will take the class in the future. We hope that you enjoy ME 122.

Staff

Course instructor: Prof. Hayden Taylor

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Telephone:	510 642-4901
Office:	6159 Etcheverry Hall
Office hours:	Fridays 3–5pm in 6159 Etcheverry, and by arrangement

Graduate student instructor: Kyle Zampaglione

E-mail:	kzampag@berkeley.edu
Office hours:	Tuesdays 3.30–4.30pm, Wednesdays 2–3pm in Hesse 136

Lectures

Lectures will take place on Mondays and Wednesdays, 4–5.30pm, in 141 McCone.

Discussions

Discussions, at which regular attendance is required, will take place in 1165 Etcheverry on Tuesdays 11am–12pm and Thursdays 5–6pm.

The Design for Manufacturing project

The semester-long project gives an opportunity to integrate all the material covered in this class. You will be working in teams to design, from scratch, a mechanical assembly to satisfy a need that you identify. You will then select materials and manufacturing processes for each component, and plan the manufacturing process for an appropriate production volume. You will not be making any physical components in a lab or workshop; this is a conceptual project in which you will learn about processing options available throughout industry. You will consult with engineers working in industry to make informed decisions. Your mechanism and process plan will be presented primarily in the form of a website. Here is a template website, prepared by Kyle: https://sites.google.com/site/me122example/home.

Homeworks

There will also be short written homeworks, approximately bi-weekly, to support learning of the technical material. Homeworks will be due by 5pm on the Friday of the week they are due. Homework questions will be released on bCourses at least one week, and usually longer, before the due date. You can either turn in your homework solutions on paper (location to be confirmed) or upload your solutions to bCourses (a scan of handwritten work is absolutely fine). We aim to return graded homework within one week of submission.

Exams

There will be two exams, one in class during week 7, and the second during the final exam slot scheduled for this class (Friday May 15, 8–11am).

Course text

The official class textbook is:

> *Manufacturing Processes for Engineering Materials*, by S. Kalpakjian and S. Schmid, 5th Edition, Prentice Hall. ISBN 978-0132272711. Library call number: TS183.K34 2008.

We have chosen this text because of its detailed coverage of a wide range of manufacturing processes, backed up by experimental data. There is more detail in the book than you will be required to know for assessments in this class; whatever is covered in lecture and discussions is what you will be expected to know for the homeworks and tests. Homework tasks will *not* be assigned directly from problems in Kalpakjian.

Other books of possible interest include the following good reference:

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, by M.P. Groover, Wiley. ISBN 978-1-1182-3146-3. Library call number: TS183.G78 2013.

An excellent text for understanding material and process selection approaches is:

Materials Selection in Mechanical Design, M.F. Ashby, Butterworth-Heinemann, ISBN 978-1-8561-7663-7. Library call number: TA403.6.A74 2011. There is also an electronic version available through the Library.

This recent book provides a vision for the future of additive manufacturing:

Fabricated: the New World of 3D Printing, H. Lipson and M. Kurman, Wiley, ISBN 978-1-1183-5063-8

This 2013 book offers a trenchant perspective on the state of manufacturing in the US and its importance to the economy:

Made in the USA: The Rise and Retreat of American Manufacturing, Vaclav Smil, MIT Press. ISBN 978-0-2620-1938-5.

Software and computing

You will be needing access to the Solidworks program to prepare the design of your project's mechanical assembly. Kyle has prepared a reference sheet containing all the information you need in this regard, and it is available on bCourses.

Grading

Students will receive a letter grade for this course, composed in the following way:

- Bi-weekly homeworks: 30%
- Two midterm exams: 30%
- Design for Manufacturing project: 40%

Academic integrity

We will be adhering to the Berkeley Honor Code (http://asuc.org/honorcode/index.php). If anyone has any questions about the responsibilities they have as part of this Code, please contact the course instructor.

Lateness and illness policy

Discussion sessions are an integral part of this class and are considered compulsory, partly because they will be the primary venue for getting feedback on the progress of your projects. However, if you fall ill we would prefer you not to come to class. A rise in 'flu cases is expected on campus during the first part of the semester, and the advice is to stay away from class if sick. If you fall ill or experience exceptional circumstances, please contact Kyle

to arrange an alternative time to complete the relevant work once you have recovered. We will *not* be requiring written excuses from medical personnel.

For written assignments turned in after the deadline with no legitimate excuse, the score for that assignment will be multiplied by the following lateness factor: $L = 0.3e^{-t/4} + 0.7e^{-t/72}$ where t is the number of hours late.

Class, discussion, and assignment schedule

Week	Day	Date	Lecture	Discussion	Assignments due	Reading
1	W	1/21	Introduction: significance of manufacturing to the US and global economies; resurgence of manufacturing in USA. Process taxonomy. Project introduction.	No discussion		
2	M	1/26	Material properties and testing	Project introduction		Kalpakjian ch. 2
	W	1/28				Kalpakjian ch. 3 (metals); ch. 10.2-10.9 (plastics); ch. 11 (ceramics)
3	M	2/2	Process- and materials-selection charts	Ashby charts and project pitch information	**Due 2/6 at 5pm**: HW1 (Processing–property relationships; process selection). E-mail project topic, pitch partner, and slide.	(Ashby, *Materials Selection in Mechanical Design*)
	W	2/4	Processing–property relationships in materials			Kalpakjian ch. 8
4	M	2/9	Process cost modelling	Project pitches and group formation	**Due 2/14 at 5pm**: Team compositions and project selections	Kalpakjian ch. 9 (subtractive); ch. 14-15 (CAD)
	W	2/11	Subtractive I: metal cutting			Kalpakjian section 10.12
5	M	2/16	Holiday			
	W	2/18	Subtractive II: abrasive, chemical, methods etc. Numerical control and CAD.	HW2 material; Google Sites intro	**Due 2/20 at 5pm**: HW2 (Subtractive processes) . Project website functional and describing project motivation with initial concepts	
6	M	2/23	Additive I: motivation for using	Quiz 1 review; grad panel		

			additive manufacturing, and types of additive process	reminder		
	W	2/25	Additive II: application case studies			Kalpakjian ch. 5
7	M	3/2	Quiz 1	Grad panel info and how to give design review	**Due 3/6 at 5pm**: HW3 (Additive processes) . **Due 3/8 at 5pm**: slides for grad panel review	
	W	3/4	Additive III: design for additive manufacturing			Kalpakjian ch. 6
8	M	3/9	Forming I: casting	Grad panel design review	**Due 3/15 at 5pm**: preliminary CAD drawings of assembly posted on project website	Kalpakjian ch. 7
	W	3/11	Forming II: bulk deformation			
9	M	3/16	Forming III: sheet forming	HW4 material; info for engineering panel	**Due 3/20 at 5pm**: HW4 (Forming processes)	Kalpakjian ch. 10
	W	3/18	Processing of plastics and composite methods			Kalpakjian ch. 4
10	3/23–3/27: Spring Break					
11	M	3/30	Surface finish, dimensional characteristics, metrology, tribology, friction, lubrication, surface treatments	*Tuesday*: Office hours/HW5 material. *Thursday*: Team-level material- and process-selection consultations with visiting engineers	**Due 3/29 at 5pm**: slides for engineering panel. **Due 4/5 at 5pm**: website updated with results of engineering panel.	Kalpakjian ch. 4
	W	4/1	Team consultations (Tuesday discussion section)			Kalpakjian ch. 12
12	M	4/6	Tolerancing; fit; geometric dimensioning and tolerancing (GD&T); quality control; statistical process control (SPC)	HW6 material; GD&T practices	**Due 4/10 at 5pm**: HW5 (Joining processes)	Kalpakjian ch. 12
	W	4/8	Joining I: welding and brazing			
13	M	4/13	Joining II: adhesives and fasteners	Presentation: process proposals; selection charts	**Due 4/19 at 5pm**: process and materials selection rationale posted on project website	
	W	4/15	Powder processing			Kalpakjian ch. 11
14	M	4/20	Micro- and nano-manufacturing I:	Peer review of GD&T	**Due 4/24 at 5pm**: HW6	Kalpakjian ch. 13

			semiconductor processing		(Micro/nano-manufacturing)	
	W	4/22	Micro- and nano-manufacturing II: lithography			
15	M	4/27	Micro- and nano-manufacturing III: tissue engineering; biomimetics	Open week, leftover material or checking of final presentations		
	W	4/29	Micro- and nano-manufacturing IV: 2D materials			
16	M	5/4	Project presentations I		**Due 5/8 at 5pm**: Final project website	
	W	5/6	Project presentations II			

Quiz 2 (length 90 minutes) will take place in the final exam slot.