

ME6101 Engineering Design:

This is a graduate level Engineering Design course taken by MS and PhD students. At the beginning of the course, students speculate about design and manufacturing of the year 2030. Then, they learn how to identify the key competencies an engineering designer should obtain in order to be successful in the world of 2030. After that, students learn about project planning and management, creativity, and ideation techniques. Then, they study and internalize the four core phases (requirements analysis, conceptual design, embodiment design, and detail design) of the Pahl & Beitz Systematic Design Approach. After that, students are asked to personalize and augment the original P&B approach in order to make it a better fit for their hypothetical design and manufacturing world of 2030. In the second half of the semester, the students apply their modified Pahl & Beitz approach to a number of actual design projects and validate it. The students are required to work in small groups and collaborate across the boundaries of campus, states, countries, continents and cultures! Additional technical topics covered in this course include: mass customization, integrated product and process design, design of mechatronic systems, aspects of ECAD-MCAD integration, and other related topics depending on prior knowledge and interest.

This course implements a pedagogical approach for mass customization of education and competency-based learning. The course has been supported by Hewlett Packard, MSC Software, Procter & Gamble, and John Deere. This course is offered in synchronous (live) mode to students at the Atlanta campus, as well as in asynchronous mode per video to distant learning students from the GT Loraine campus (France) and across the country. Occasionally, we have also had industry participants residing in the Netherlands, India, or the Arab Emirates.

Design Education for the Globalized World of near Tomorrow – Learning how to learn.

ME6102 Designing Open Engineering Systems is a graduate level design course taught by Dr. Dirk Schaefer at Georgia Tech every spring semester. Students are exposed to an open-ended cross-disciplinary design problem, which serves as a vehicle for them to learn about a systematic engineering design, complex engineered systems, openness, product platform design, mass customization, as well as elements of systems engineering. The course is simultaneously offered to both on-campus and distance learning students from across the US and overseas. What makes this course unique is that all students collectively form a self-organizing team (or a small number of competing teams) of distributed individuals to address the given design challenge by utilizing highly topical paradigms related to Social Product Development, including crowd-sourcing, mass-collaboration, and cloud-based design and manufacturing, in addition to their core engineering competencies. Students develop the competencies required to collaborate in a globally dispersed virtual setting and learn how to best leverage what each individual has to offer to succeed collectively. Fierce competition is replaced by a *share-to-gain* philosophy. The underlying pedagogical framework of the course includes elements of active learning, problem-based learning, collaborative and collective learning, reflective practice, and threshold concepts. In concert, these concepts foster deep learning among students and help them to *learn how*

to learn and take charge of their own learning. Many educators consider this a key competency required for the next generation of engineers to succeed in the globalized world of near tomorrow. – Two very cool end-of-semester presentations from spring 2012 are on YouTube: <http://youtu.be/p7uFPVAwWIY>

Here are two quotes from former students:

“ME6102 helped open my eyes to the 'bigger picture' within engineering design. I realized that the traditional mindset of protecting technology and withholding design information can act as a barrier to engineering development and business success. ME6102 allowed me to understand that design methods can incorporate collaborative tools and leverage them for the benefit of all involved.” - Gunnar Bergeson, Rotor Systems Designer - The Boeing Co. - Mesa, AZ (Spring 2011).

“You have inspired me to be a lifetime learner, to set high goals, to diligently plan for the future, and to truly reflect internally on what is important to me. You have given me the tools to be a successful engineer now, and into the future. Your courses, more than any other I have ever taken, have helped me understand the true power of engineering, and how it can be applied to all aspects of life. Thank you!” – Jason Komorowski, Intel Corporation, TME-A AMHS Product Engineer, Santa Clara, CA (Spring 2012).

Related papers:

- 2012 J **Schaefer, D.**, Thames, J.L., Wellman, R., Wu, D., and D. Rosen (2012): **“Distributed Collaborative Design and Manufacture in the Cloud – Motivation, Infrastructure, and Education.”** *ASEE Computers in Education Journal (CoED)*, Vol. 3, No. 4, October-December 2012, pp. 1-16. [[pdf](#)]
- J **Schaefer, D.**, Panchal, J.H., Thames, J.L., Haroon, S., and F. Mistree (2012): **“Educating Engineers for the Near Tomorrow”**, *International Journal of Engineering Education (IJEE)*, Vol. 28, No. 2, 2012, pp. 381-396. [[pdf](#)]
- BC Mistree, F., Panchal, J.H., and **D. Schaefer** (2012): **“Mass-Customization: From Personalized Products to Personalized Engineering Education”**. In: Y. Xiong (Ed.), *Pathways to Supply Chain Excellence*, INTECH, ISBN 978-953-51-0367-7, chapter 9, pp. 149-174. [[pdf](#)]
- C Rosen, D. W., **Schaefer, D.**, and D. Schrage (2012): **“GT MENTOR: A High School Education Program in Systems Engineering and Additive Manufacturing”** *Proceedings of the 23rd Annual International Solid Freeform Fabrication Symposium – An Additive Manufacturing Symposium (SFF 2012)*. Austin, Texas, August 6-8, 2012. [[pdf](#)]
- C Siddique, Z., Panchal, J., **Schaefer, D.**, Haroon, S., Allen, J.K., and F. Mistree (2012): **“Competencies for Innovating in the 21st Century.”** *ASME 2012 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC 2012)*, Chicago, Illinois, August 12-15, 2012, paper # DETC2012-71170. [[pdf](#)]
- 2011 C **Schaefer, D.**, Panchal, J.H., Haroon, S., and F. Mistree (2011): **“Design Education for the World of Near Tomorrow: Empowering Students to Learn How to Learn.”** *ASEE 2011 Annual Conference and Exposition*, Vancouver, British Columbia, Canada, June 26-29, 2011, paper # AC2011-512. [[pdf](#)]
- C **Schaefer, D.**, Thames, J.L., Panchal, J.H., Haroon, S., and F. Mistree (2011): **“Innovative Design Education in a Global Distance Learning Setting.”** *Mudd Design Workshop VIII “Design Education: Innovation and Entrepreneurship”*, Harvey Mudd College, Claremont, California, USA, May 26-28,

2011. [\[pdf\]](#)

- 2009 J Rippel, M., Panchal, J.H, **Schaefer, D.** and F. Mistree (2009): "**Fostering Collaborative Learning and Educational Mass Customization in a Graduate Level Engineering Design Course.**" *International Journal of Engineering Education (IJEE)*, Vol. 25, No. 4, pp. 729-744. [\[pdf\]](#)
- J **Schaefer, D.** and J. H. Panchal (2009): "**Incorporating Research into Undergraduate Design Courses: A Patent-centered Approach.**". *International Journal of Mechanical Engineering Education (IJMEE)*, Volume 37, Number 2, April 2009, pp. 98-110. [\[pdf\]](#)
- 2008 J **Schaefer, D.**, Panchal, J.H., Choi, S.K and F. Mistree (2008): "**Strategic Design of Engineering Education for the Flat World.**" *International Journal of Engineering Education (IJEE)*, Vol. 24, No. 2, pp. 274-282. [\[pdf\]](#)