

To: The Engineering Faculty
From: The Department of Engineering Education
Re: New Graduate Level Course – ENE 602

The faculty of the Department of Engineering Education has approved the following new graduate ENE course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ENE 602 Engineering Education Perspectives
Sem. 1. Cr. 3. Admission by consent of instructor.

Description: Perspectives on the field of engineering education. Emphasis is placed on students' development of a personal identity within the scholarship of engineering education including engineering practice, teaching engineering, and engineering education research.

Reason: This is a required course for the graduate programs in the Department of Engineering Education (ENE). This new course will also be of interest to graduate students in other Departments, Schools, and Colleges with engineering education or related interests. The intent of the course is to introduce students to the field of engineering education while broadening their views of the roles of and interrelationships between teaching and research.

This course was offered in Fall 2005 as ENE 595A – Introduction to Engineering Education. Fifteen students, including students from ENE, various graduate programs in Engineering, Science Education, and Technology, were enrolled.

Kamyar Haghighi, Head
Engineering Education

ENE 602 Engineering Education Perspectives Syllabus

COURSE DESCRIPTION:

This course introduces students to the field of engineering education. Emphasis will be placed on students' development of a personal identity within the scholarship of engineering education including engineering practice, teaching engineering, and engineering education research.

COURSE LEARNING OBJECTIVES:

As a result of taking this course, the participants will develop the knowledge and skills to:

1. Define engineering and the engineering method, and list attributes of engineering as a profession.
2. Describe the context of engineering education in the US and globally
3. Describe the history, the present, and the future scenarios of engineering and engineering education
4. Summarize "state of the art" or "best" practices for teaching and learning engineering
5. Describe drivers and opportunities that are enabling engineering education research
6. Map the landscape of engineering education research
7. Describe the elements of an engineering education research study
8. Articulate a clear personal teaching philosophy statement.
9. Articulate a clear personal research philosophy statement.

GRADING POLICY:

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|--------------------------------------|-----|
| • Participation | 10% |
| • Preparation | 10% |
| • Engineering & Engineering Practice | 20% |
| ○ Auto-Biographical Reflection | |
| ○ Elevator Speech Draft | |
| ○ Elevator Speech Final | |
| • Teaching in Engineering Education | 20% |
| ○ Auto-Biographical Reflection | |
| ○ Teaching Philosophy Draft | |
| ○ Teaching Philosophy Final | |
| • Research in Engineering Education | 20% |
| ○ Auto-Biographical Reflection | |
| ○ Research Philosophy Draft | |
| ○ Research Philosophy Final | |
| • Best Practices Presentation | 20% |

GENERAL COURSE POLICIES:

Attendance and participation in class activities and discussion, and timely submission of assignments is required. Excellence is expected in all written work. Written assignments must be well-organized and proofread for spelling and meaning.

COURSE OUTCOMES / PRODUCTS:

By the end of the course, participants will have developed a first set of engineering education philosophy statements. These philosophy statements will be developed through a series of revision cycles and include the following topics: engineering practice and engineering education, engineering teaching, and engineering education research. A common feature of these philosophy statements is that they represent YOUR choices about what is important (e.g., your beliefs, attitudes, priorities, and conceptions), and as such are likely to change over time as your identity as an engineering educator evolves. The rationale for incorporating them in this introductory course is that they provide an entry point for discussing your ideas about engineering education (such as a conversation starter) and an initial framework for organizing your current views and exploring future ideas.

As a class, participants will also collaboratively create the following tools and frameworks:

- Landscape of engineering practice
- Landscape of engineering “drivers” (those who influence engineering education)
- Best practices in engineering education teaching
- Landscape of engineering education research
- Frameworks for designing engineering education research studies

Schedule of Topics and Assignments

Week	Topics	Assignments Posted
1	Course Syllabus & Expectations Community Building What is engineering practice? <ul style="list-style-type: none"> • Landscape of Engineering Practice 	ABR I – Engineering. & Engineering Practice Reading – Engineering Education Landscape: Drivers, Opportunities, and Challenges ¹⁻⁵
2	What are ways to influence (change) engineering education? <ul style="list-style-type: none"> • Drivers, Opportunities, & Challenges • Theories of Change 	Elevator Speech Draft Landscape of Engineering Education “Drivers” Reading – More on Drivers ^{6,7}
3	What are opportunities for change? <ul style="list-style-type: none"> • Homework Report Out – Driver Investigation Revisit: What is engineering practice? <ul style="list-style-type: none"> • Peer Review Elevator Speech • Develop review criteria • Instructor Feedback on ABR I 	Best Practices in Engineering Teaching and Learning - List of 10+ Landscape of Engineering Education: The National Science Foundation as a Driver ABR II – Teaching Engineering Reading - Collaborative / Cooperative Learning ⁸⁻¹⁰
4	What are best practices in engineering teaching and learning? <ul style="list-style-type: none"> • Insights from the learning sciences • Landscape view • Investigate “Collaborative / Cooperative Learning” as a best practice 	Elevator Speech Final Reading - Teaching Philosophies ¹¹ <ul style="list-style-type: none"> • Locate two teaching philosophies on the Web. Reading - Reflections on Teaching or Thinking about Teaching ^{12,13} Best Practices in Engineering Teaching and Learning – Team Assignment

Week	Topics	Assignments Posted
5	Cooperative Learning <ul style="list-style-type: none"> • Define what is cooperative learning (consensus) and discuss how to improve CL activities What is a teaching philosophy? <ul style="list-style-type: none"> • Identify purpose of teaching philosophy • Develop and test rubrics to evaluate teaching philosophy content and style • Broaden vision of what your teaching philosophy could comprise 	Reading - Teaching Philosophy ¹⁴ Reading - Teaching & Learning is Disciplinary ¹⁵ Reading for Best Practice 1 – Problem-Based Learning ¹⁶ Reading for Best Practice 2 – Teaching Pedagogies for Diverse Learners ¹⁷
6	What are best practices in engineering teaching and learning? <ul style="list-style-type: none"> • Best Practices Presentations: <ul style="list-style-type: none"> ○ Problem-Based Learning ○ Teaching Pedagogies for Diverse Learners 	Best Practices in Engineering Teaching & Learning - Reflection Teaching Philosophy Rubric – Putting it to Test Reading for Best Practice 3 - Performance Based Assessment / Authentic Assessment ¹⁸ Reading for Best Practice 4 – Learning from Failure ¹⁹ Readings – Teaching Philosophies ²⁰
7	What are best practices in engineering teaching and learning? <ul style="list-style-type: none"> • Best Practices Presentations: <ul style="list-style-type: none"> ○ Performance Based Assessment / Authentic Assessment ○ Learning from Failure What is a “good” teaching philosophy? <ul style="list-style-type: none"> • Generating a Rubric 	Frontiers in Education 2005 <ul style="list-style-type: none"> • Global/International Paper • Education Research Paper Reading for Best Practice 5 – Learning Communities ²¹
8	What are best practices in engineering teaching and learning? <ul style="list-style-type: none"> • Best Practices Presentations: <ul style="list-style-type: none"> ○ Learning Communities How do best practices relate to the teaching philosophy? Navigating FIE	Teaching Philosophy Draft What is Engineering Education? - read and dissect 2 research papers <ul style="list-style-type: none"> • FIE paper • Best Practice related paper
9	FRONTIERS IN EDUCATION (FIE)	•
10	What is the engineering education landscape? <ul style="list-style-type: none"> • Debrief global perspectives (FIE paper) • Debrief education research papers • Creating an engineering education research landscape based on the EERC 	ABR III – Engineering Research Reading - Perspectives on Research ²²⁻²³ Expanding the Research Landscape – Generate 10 research question with an EERC theme
11	What is engineering education research? <ul style="list-style-type: none"> • Comparing research in the physical and social sciences • Identifying the necessary knowledge and skills • Questions, methods, and evidence • Generate a research question 	Reading - Qualitative and Quantitative Research ²⁴⁻²⁶ Peer Feedback on Teaching Philosophy Drafts Mapping research questions, evidence, and methods – refining your research question
12	What is engineering education research? <ul style="list-style-type: none"> • Comparing modes of inquiry What is a research philosophy? <ul style="list-style-type: none"> • Finding your research identity 	Reading - Development of a Research Study ²⁷ Reading - Debate on the Nature of Education Research ²⁸ Reading - Research Philosophies <ul style="list-style-type: none"> • Locate two research philosophies on the Web.

Week	Topics	Assignments Posted
13	Teaching Philosophy <ul style="list-style-type: none"> • Redevelop rubrics to evaluate teaching philosophy Research Philosophy <ul style="list-style-type: none"> • Develop and test rubrics to evaluate research philosophy 	Teaching Philosophy Final Research Philosophy Draft Reading - On Becoming an Engineering Education Researcher ²⁹ Reading - On Preparing Engineering Education Scholars ³⁰
14	THANKSGIVING	
15	Engineering education research <ul style="list-style-type: none"> • Identify challenges / strategies about research philosophy statements • Summarize features of engineering education research Engineering education as a profession <ul style="list-style-type: none"> • Characterize attributes of a profession - Link to preparation for engineering education profession • Characterize forms of scholarship - Link to forms of scholarship in engineering education • Design an engineering education program 	Peer Feedback on Research Philosophy Drafts Peer Evaluation on Teaching Philosophy Finals Research Philosophy Final Written Course Evaluation
16	Research Philosophies <ul style="list-style-type: none"> • Identify challenges / strategies about research philosophy statements • Provide peer feedback on strengths and what needs improvement Elevator Speeches Revisited <ul style="list-style-type: none"> • Reflect on “your role” – has it changed? Engineering education research – What does it look like? <ul style="list-style-type: none"> • Attend an MS Defense 	

1. Reynolds, T. S. and B. E. Seeley (1993). “Striving for Balance: A Hundred Years of the American Society for Engineering Education.” *Journal of Engineering Education*, 82 (3), pp. 136 – 151.
2. Seeley, B. E. (1999). “The Other Re-engineering of Engineering Education, 1900-1965.” *Journal of Engineering Education*, July, pp. 285-294.
3. Seymour, E. (2001). “Tackling the Processes of Change in US Undergraduate Education in Science, Mathematics, Engineering, and Technology.” *Science Education*, 86, pp. 79-105.
4. Purdue University Strategic Plan. http://www.purdue.edu/strategic_plan.
5. College of Engineering Strategic Plan. https://engineering.purdue.edu/Engr/DOE/SPA/StrategicPlan/2002-2007/PDF/strategic_plan.pdf
6. National Resource Council (1999). *How People Learn: Brain, Mind, Experience, and School, Expanded Edition*, (pp. 14-26, “Learning: From Speculations to Science”). Washington, DC: National Academy Press.
7. Halpern, D. F. and M.D. Hake (2003). “Applying the Science of Learning to the University and Beyond.” *Change*, July/August, pp. 36-41.
8. Springer, L., M. E. Stanne, and S. D. Donovan (1999). “Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering, and Technology: A Meta-Analysis.” *Review of Educational Research*, Vol. 69, No. 1, pp. 21-51. *Useful meta-analysis*.
9. Johnson, D.W., R.T. Johnson, and K.A. Smith (1998). “Cooperative Learning Returns to College: What Evidence Is There That It Works?” *Change*, July/August, pp. 27-35.
10. Smith, K.A., S.D. Sheppard, D.W. Johnson, and R.T. Johnson (2005). “Pedagogies of Engagement: Classroom-Based Practices.” *Journal of Engineering Education*, January, pp. 87-101.

11. Schonwetter, D.J., L. Sokal, M. Friesen and K.L. Taylor (2002). "Teaching philosophy reconsidered; A conceptual model for the development and evaluation of teaching philosophy statements." *The International Journal for Academic Development*, Vol. 7, No. 1, pp. 83-97.
12. Duckworth, E. R. (1996). *"The having of wonderful ideas" & other essays on teaching & learning*. New York: Teachers College Press. (Chapter 10 "Teaching as Research")
13. Minstrell, J. A. (1989). Teaching Science for Understanding. In L.B. Resnick and L. E. Klopfer (Eds.), *Toward the Thinking Curriculum: Current Cognitive Research* (pp. 130-149). Alexandria, VA: ASCD.
14. Scott, S.M., Chovanec, D.M., and Young, B. (1994). Philosophy in Action in University Teaching. *The Canadian Journal of Higher Education*, 24, 1-25.
15. Huber, M.T. (2002). "Disciplinary Styles in the Scholarship of Teaching: Reflections on The Carnegie Academy for the Scholarship of Teaching and Learning." In M.T. Huber and S.P. Morrelae (Eds.), *Disciplinary Styles in the Scholarship of Teaching and Learning: Exploring Common Ground*. Washington, DC: American Association for Higher Education and The Carnegie Foundation for the Advancement of Teaching.
16. Dolmans, D.H.J.M., De Grave, W., Wolfhagen, I.H.A.P, and Van Der Vleuten, C.P.M. (2005). Problem-based learning: future challenges for educational practices and research. *Medical Education*, 39, 732-741.
17. Beck, C.R. 2001. Matching Teaching Strategies to Learning Styles Preferences. *The Teacher Educator*. 37(1), 1-15.
18. Svinicki, M.D. (2004). Authentic Assessment: Testing in Reality. *New Directions for Teaching & Learning*, 100, 23-29.
19. Alfi, O., A. Assor and I. Katz (2004). Learning to Allow Temporary Failure: Potential Benefits, Supportive Practices and Teacher Concerns Availability. *Journal of Education for Teaching*, 30(1), 27-41.
20. Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15 (2), 4-14.
21. McIntosh, Joshua G. and Peckskamp, Terra L. (2005). Learning Communities: A Review of the Literature. *Talking Stick*, April, 1-6.
22. Berliner, D. C. (2002). "Educational Research: The Hardest Science of All." *Educational Researcher*, Vol. 31, No. 8, pp. 18-20.
23. Laughlin, R.B. (2005). "Reinventing Physics: the Search for the Real Frontier." *The Chronicle of Higher Education*, Issue dated February 11, 2005.
24. Guba, E.G. and Lincoln, Y.S. (1994). "Competing Paradigms in Qualitative Research." In N.K. Denzin and Y.S. Lincoln (Eds.), *Handbook of Qualitative Research* (Chapter 6). Thousand Oaks, CA: Sage.
25. Creswell, J.W. (2003). "A Framework for Design." pp. 3-26 in *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: SAGE Publications.
26. Leydens, J.A., Moskal, B.M., and Pavelich, M.J. (2004). "Qualitative Methods Used in the Assessment of Engineering Education." *Journal of Engineering Education*, Vol. 93, No. 1, pp.65-72.
27. Janesick, V.J. (1994). "The Dance of Qualitative Research: Metaphor, Methodolatry, and Meaning." In N.K. Denzin and Y.S. Lincoln (Eds.), *Handbook of Qualitative Research* (Chapter 12). Thousand Oaks, CA: Sage.
28. National Research Council (2002). "Guiding Principles for Scientific Inquiry." *Scientific Research in Education*. Committee for Scientific Principles for Education Research. Shavelson, RJ and Towne, L (Eds.). Center for Education. Division of Behavioral Sciences and Education. Washington, DC: National Academy Press.
29. Eisenhart, M. and R.L. DeHaan (2005). "Doctoral Preparation of Scientifically Based Education Researchers." *Educational Researcher*, Vol. 34, No. 4, pp. 3-13.
30. Braxton, J.M., W. Luckey and P. Helland (2002). *Institutionalizing a Broader View of Scholarship Through Boyer's Four Domains*. ASHE-ERIC Higher Education Report: Volume 29, No. 2, A. J. Kezar series editor. Jossey-Bass.