DEPARTMENT OF
BIOMEDICAL ENGINEERING
INSTRUCTIONAL INCUBATOR
UNIVERSITY OF MICHIGAN

WEEKLY COURSE SYLLABUS – FALL 2017*

Week	Date	Tuesday (Experiential)	Thursday (Discussion)
1	09.5	*Course Introduction:* Why are we here?	Active Learning
2	09.12	*Customer Discovery:* Current BME Experiential Curriculum and the Students	Learning Theories I: General Introduction
3	09.19	*Customer Discovery:* Stakeholder Needs	Learning Theories II: Situational Learning
4	09.26	*Customer Discovery:* Master Class	Introduction to Pedagogy/Conceptual Change
5	10.03	Computational Modeling with Matlab	Pedagogical Content Knowledge
6	10.10	Group Work: Conceptualizing a Cell Signaling Module	*BMES Conference* Metacognition
7	10.17	***Fall Break***	Brainstorming: Ideation for Course Development
8	10.24	Group Presentations: Cell Signaling Modules	Group Work: Conceptualizing courses
9	10.31	*Group Presentations:* Module Selection	Collaborative Learning (vs. Cooperative learning)
10	11.07	Group Work/1:1	Problem Based Learning (vs. Project Based Learning)
11	11.14	*Group Presentations:* Draft Syllabus	Assessment
12	11.21	Group Work/1:1	***Thanksgiving***
13	11.28	*Group Presentations:* Draft Assignments/Misconceptions	Classroom Discourse and Effective Questioning
14	12.05	Group Work/1:1	Reflective: Learning Theories and Active Learning
15	12.12	Student Presentations: Final Course Design	Course Wrap-Up
	12.19	***Finals***	***Finals***

** Subject to change at the discretion of the Instructor.*

DEPARTMENT OF BIOMEDICAL ENGINEERING INSTRUCTIONAL INCUBATOR
UNIVERSITY OF MICHIGAN

WEEKLY COURSE ASSIGNMENTS – FALL 2017*

Note:

1. **Assignment Dates**: Assignments are listed for the day they are due. For example: 09.05 (Tuesday): Pre-class Survey indicates that the Pre-class Survey must be completed by 3:00 p.m., Tuesday, 09.05.
2. **Readings:** pdfs of readings can be found on the course Canvas site by week in folders labeled by Week and Day (e.g. W2.Tu)
3. **Thursday Discussion Questions:** Students should be prepared to answer all Thursday discussion questions every week. Discussion leads are required to submit written responses to Canvas prior to the start of class. Group leads are welcome to seek input from other classmates when preparing their written responses prior to submission.
4. **(I)/ (G):** Indicates individual (I) or group (G) assignment. All students must submit their individual assignments to the course Canvas site prior to the start of class.

Week	Date	Tuesday (Experiential)	Thursday (Discussion)
0		Pre-class Survey	
1	09.5	W1.Tu Pre-readings Student Reflection (I)	W1.Th Readings & Discussion Questions
2	09.12	W2.Tu Pre-readings BME Curriculum & the Student Assignment (I)	W2.Th Readings & Discussion Questions
3	09.19	W3.Tu Pre-readings BME Stakeholders (I)	W3.Th Readings & Discussion Questions
4	09.26	W4.Tu Pre-readings Masterclass Report (I)	W4.Th Readings & Discussion Questions
5	10.03	W5.Tu Pre-readings	W5.Th Readings & Discussion Questions
6	10.10	Matlab Assignment (G)	W6.Th Readings & Discussion Questions
7	10.17	**Fall Break**	W7.Th Readings & Discussion Questions
8	10.24	Student Revised Matlab Class Presentations (G)	W8.Th Readings & Discussion Questions

9	10.31	Module Selection (G)	W8.Th Readings & Discussion Questions
10	11.07	N/A	W9.Th Readings & Discussion Questions
11	11.14	Draft Syllabus (G)	W10.Th Readings & Discussion Questions
12	11.21	N/A	**Thanksgiving**
13	11.28	Draft Assignments/Misconceptions (G)	W11.Th Readings & Discussion Questions
14	12.05	N/A	W12.Th Readings & Discussion Questions
15	12.12	Final Course Design (G)	Post-Course Survey

DEPARTMENT OF
BIOMEDICAL ENGINEERING
INSTRUCTIONAL INCUBATOR
UNIVERSITY OF MICHIGAN

WEEKLY COURSE READINGS – FALL 2017*

(All readings can be found on the course website. References listed are as of 08.25.17 and will likely be updated during the course. The course Canvas site will be the most up to date.)

Students should be prepared to discuss questions in class. Group Leads are required to submit written responses to at least 3 questions when they are responsible for leading the discussion. Written responses for each question should be between 250 and 500 words.

[R] Denotes Required Reading

Folder Name	References	Discussion Questions
W1.Tu	**[R]** Froyd, J. E., Wankat, P. C., & Smith, K. A. (2012). Five major shifts in 100 years of engineering education. *Proceedings of the IEEE*, *100*(SPL CONTENT), 1344–1360. **[R]** National Research Council. (2000). Learning: From Speculation to Science. In *How People Learn: Brain Mind, Experience, and School* (pp. 3–27). **[R]** Leydens, J. a, Moskal, B. M., & Pavelich, M. J. (2004). Qualitative Methods Used in the. *Journal of Engineering Education*, *93*(1), 65–72. McTighe, J., & Wiggins, G. (2012). Understanding By Design® Framework. *Alexandria, VA: Association for Supervision…* 1–13. Retrieved from ftp://ftp1.sd34.bc.ca/ProD/VC/BackwardDesign/UbD_WhitePaper0312.pdf Wiggins, G., & McTighe, J. (1998). What is backward design? *Understanding by Design*, 7–19.	
W1.Thu (Active Learning)	**[R]** Prince, M. (2004). Does Active Learning Work ? A Review of the Research. *J. Enger. Education*, *93*(July), 223–231. **[R]** Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Pnas*, *111*(23), 8410–8415. http://doi.org/10.1073/pnas.1319030111 **[R]** Christie, M., & de Graaff, E. (2017). The philosophical and pedagogical underpinnings of Active Learning in Engineering Education. *European Journal of Engineering Education*, *42*(1), 5–16. Goffe, W. L., & Kauper, D. (2014). A Survey of Principles Instructors: Why Lecture Prevails. *The Journal of Economic Education*, *45*(4), 360–375.	What images or definitions of active learning come up across the readings? Why is active learning receiving attention in the literature? What are the roles of the instructor/student in active learning? What are some challenges to

		active learning?
W2.Tu	**[R]** Newstetter, W. C. (2006). Fostering integrative problem solving in biomedical engineering: The PBL approach. *Annals of Biomedical Engineering*, *34*(2), 217–225. http://doi.org/10.1007/s10439-005-9034-z	
W2.Thu (Learning Theories vs Learning Styles)	**[R]** Kirschner, P., & van Merriënboer, J. J. G. (2013). Do learners really know best? Urban legends in education. *Educational Psychologist*, *48*(3), 169–183. **[R]** Felder, R., & Silverman, L. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(June), 674–681. **[R]** Newstetter, W. C., & Svinicki, M. D. (2014). *Learning theories for engineering education practice*. *Cambridge handbook of engineering education research*. Howard-Jones, P. a. (2014). Neuroscience and education: myths and messages. *Nature Reviews. Neuroscience*, *15*(12), 817–824. Felder, R. M., & Spurlin, J. (2005). Applications, Reliability and Validity of the Index of Learning Styles. *International Journal of Engineering Education*, *21*(1), 103–112. Felder, R., & Brent, R. (2005). Understanding student differences. *Journal of Engineering Education*, *94*(1), 57–72.	What are the differences between learning theories and styles? How can a theory be helpful in practice or not? How can a style be helpful in practice or not? Why is there a debate about learning styles?
W3.Tu	**[R]** Constable, G. (2014). *Talking to humans*.	
W3.Thu (Situated Learning)	**[R]** Johri, A., Olds, B. M., Esmonde, I., Madhavan, K., Roth, W. M., Schwartz, D. L., … Tabak, I. (2011). Situated engineering learning: Bridging engineering education research and the learning sciences. *Journal of Engineering Education*, *100*(1), 151–185. **[R]** Palincsar, A. (1998). Social constructivist perspectives on teaching and learning. *Annual Reviews in Psychology*, *49*, 345–375. **[R]** Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Research*, *18*, 32–42. Lave, J. (1991). Chapter 4 Situating Learning in Communities of Practice. *Perspectives on Socially Shared Cognition*, *2*, 63–82. Bruer, J. T. (1997). Education and the brain: A bridge too far. *Educational Researcher*, *26*(8), 4–16. Hutchins, E. (2005). Distributed cognition. *International Encyclopedia of the Social & Behavioral Sciences*, *7*(1), 5–5.	How can we use learning theories to enhance the engineering classroom? What is situated learning claiming? Is there one “right” learning theory?
W4.Tu	**[R]** Richardson, M. O. (2000). Peer Observation: Learning From One Another. *The NEA Higher Education Journal*, *16*(1), 9–20.	

DEPARTMENT OF BIOMEDICAL ENGINEERING INSTRUCTIONAL INCUBATOR
UNIVERSITY OF MICHIGAN

W4.Thu (Pedagogy)	**[R]** Litzinger, T. A., Lattuca, L. R., Hadgraft, R. G., & Newstetter, W. C. (2011). Engineering Education and the Development of Expertise. *Journal of Engineering Education*, *100*(1), 123–150. **[R]** Smith, K., Sheppard, S., Johnson, D., & Johnson, R. (2005). Pedagogies of Engagement: Classroom-Based Practices. *Journal of Engineering Education*, *94*(January), 87–101. **[R]** Dotger, B. H. (2015). Core Pedagogy. *Journal of Teacher Education*, *66*(3), 215–226.	What do we mean by pedagogy? How is pedagogy different than learning theory? How is it different than content knowledge? What pedagogies do you remember from your engineering classes?
W5.Thu (Pedagogical Content Knowledge)	**[R]** Shulman, L. S. (1987). Knowledge and Teaching: Foundations of the New Reform. *Harvard Educational Review*, *57*(1), 1–21. **[R]** Magnusson, S. J., Borko, H., & Krajcik, J. (1999). Nature, Sources, and Development of Pedagogical Content Knowledge for Science and Teaching. In *Examining Pedagogical Content Knowledge* (pp. 91–126). **[R]** Fraser, S. P. (2016). Pedagogical Content Knowledge (PCK): Exploring its Usefulness for Science Lecturers in Higher Education. *Research in Science Education*, *46*(1), 141–161. Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. Padilla, K., & Van Driel, J. (2011). The relationships between PCK components: the case of quantum chemistry professors. *Chemistry Education Research and Practice*, *12*(3), 367–378.	What is PCK? How is considering PCK useful in the engineering classroom? How is it useful to you as an instructor?
W6.Tu	**[R]** Committee on Undergraduate Science Education National Research Council. (1997). Science Teaching Reconsidered. *Sciences-New York*, 88. http://doi.org/10.17226/5287	
W6.Thu (Metacognition)	**[R]** Vos, H., & de Graaff, E. (2004). Developing metacognition: a basis for active learning. *European Journal of Engineering Education*, *29*(4), 543–548. **[R]** Palincsar, A. S., & Brown, A. L. (1984). Reciprocal Teaching of Comprehension- Fostering and Comprehension- Monitoring Activities. *Cognition and Instruction*, *1*(2), 117–175. **[R]** O. Lawanto, "Students' Metacognition During an Engineering Design Project," *Perform. Improv. Q.*, vol. 21, no. 2, pp. 43–60, 2008.	What are we trying to achieve when we talk about metacognition? Why is this important? What is the teacher's role in encouraging meta-cognition? How can we make

		connections across reflection, metacognition, and questioning?
W9.Thu (Collaborative Learning)	**[R]** Blasco-Arcas, L., Buil, I., Hern??ndez-Ortega, B., & Sese, F. J. (2013). Using clickers in class: The role of interactivity, active collaborative learning and engagement in learning performance. *Computers and Education*, *62*, 102–110. **[R]** Kyndt, E., Raes, E., Lismont, B., Timmers, F., Cascallar, E., & Dochy, F. (2013). A meta-analysis of the effects of face-to-face cooperative learning. Do recent studies falsify or verify earlier findings? *Educational Research Review*, *10*, 133–149. **[R]** Terenzini, P. T., Cabrera, A. F., Parente, J., & Bjorklund, S. (2001). Collaborative Learning vs . Lecture / Discussion : Students ' Reported Learning Gains *. *Journal of Engineering Education*, (634066), 123–130.	What do we mean when we talk about group learning? Do we need to make a distinction between collaborative and cooperative learning? As a pedagogical strategy, what are its/each's benefits and weaknesses? In what instances might this be an effective tool for learning?
W10.Thu (Problem Based Learning)	**[R]** Kolmos, A., & De Graaff, E. (2014). Problem-based and project-based learning in engineering education: Merging models. *Cambridge Handbook of Engineering Education Research*, 141–160. **[R]** Perrenet, J. C., Bouhuijs, P. a. J., & Smits, J. G. M. M. (2000). The Suitability of Problem-based Learning for Engineering Education: Theory and practice. *Teaching in Higher Education*, *5*(3), 345–358. **[R]** Mills, J. E., & Treagust, D. F. (2003). Engineering Education - Is Problem-Based or Project-Based Learning the Answer. *Australasian Journal of Engineering Education*, *3*(2), 2–16.	What do we mean when we talk about project- or problem-based learning? Do we need to make a distinction between project- or problem-based learning? As a pedagogical strategy, what are its/each's benefits and weaknesses? In what instances might this be an effective tool for learning?

W11.Tu (Instructional Design)	**[R]** Arreola, R. A. (1998). *Writing learning objectives. Assessing Student Learning Outcomes: A Workshop Resource Document.* **[R]** Rensselaer Polytechnic Institute. (2013). *Assessment at Rensselaer.*	
W11.Thu (Revisiting Assessment)	**[R]** Pellegrino, J. W. (2002). Knowing what students know. *Issues in Science and Technology*, *19*(2), 48–52. **[R]** Olds, B. M., Moskal, B. M., & Miller, R. L. (2005). Assessment in Engineering Education: Evolution, Approaches and Future. *Journal of Engineering Education*, *94*(January), 13–25. **[R]** Yorke, M. (2014). Formative Assessment in Higher Education : Moves Towards Theory and the Enhancement of Pedagogic Practice Formative assessment in higher education : Moves towards theory and the enhancement of pedagogic practice. *Higher Education*, *45*(4), 477– Lau, A. M. S. (2015). "Formative good, summative bad?" – A review of the dichotomy in assessment literature. *Journal of Further and Higher Education*, *0*(0), 1–17. http://doi.org/10.1080/0309877X.2014.984600	What are the several different ways the term "assessment" is used in education literature? How do we assess learning in engineering education? What does that mean for teacher and student?
W13.Thu (Discourse)	**[R]** Carlsen, W. S. (1992). Closing Down the Conversation: Discouraging Student Talk on Unfamiliar Science Content. *Journal of Classroom Interaction*, *27*(2), 15–21. **[R]** Owens, M. T., Seidel, S. B., Wong, M., Bejines, T. E., Lietz, S., Perez, J. R., … Tanner, K. D. (2017). Classroom sound can be used to classify teaching practices in college science courses. *Proceedings of the National Academy of Sciences*, *114*(12), 3085–3090. **[R]** Repice, M. D., Sawyer, R. K., Hogrebe, M. C., Brown, P. J., Luesse, S. B., Gealy, D. J., & Frey, R. F. (2016). Talking Through the Problems: A Study of Discourse in Peer-Led Small Groups. *Chem. Educ. Res. Pract.*, *17*, 555–568.	What do we mean when we say classroom discourse? How can discourse encourage or prevent learning? How can one prepare for discourse? What other aspects of learning environments can encourage or prevent learning?