Washington University in St. Louis
SCHOOL OF ENGINEERING & APPLIED SCIENCE

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TEACHING STATEMENT

Objectives and philosophy- I believe the gathering, curation and effective dissemination of knowledge is the foremost function of a professor. As an educator I will seek to impart to my students at all levels a perspective of chemical engineering that is:

i. Broad – To demonstrate that core ideas and principles are applicable to a variety of disparate problems (eg: mass transfer in transdermal drug delivery, reaction engineering in batteries, mass balances to quantify melting polar ice caps etc.)
ii. Holistic – To view the various ChE core courses as part of a whole leading to their integration in a capstone design project (and beyond, as practicing engineers).
iii. Practical - To demonstrate application of the theory learnt in the classroom in the real world via practical problems, laboratory instruction and interaction with outside practitioners.

To achieve these objectives, I will continually educate myself on engineering education best practices[1], incorporate laboratory components into the courses I instruct and tailor my instructional method to reach students of all learning styles[2]. *I will seek to develop an inductive, experiential approach to classroom teaching, helping my students see the little details in the big picture.*

Background and experience – The experience I have gained assisting in the teaching of 9 courses across the spectrum of ChE, from the sophomore level to the advanced PhD level, has prepared me well to serve as an instructor teaching the traditional chemical engineering core. During my postdoctoral program, I have served as Assistant to Instructor and Support to Instructor respectively for courses on Electrochemical Engineering and Energy Conversion and Storage at Washington University in St. Louis (WUSTL), where I have been actively involved in class planning and laboratory sessions in addition to traditional Teaching Assistant roles. Beyond traditional classroom instruction, I developed modules of practical problems for the Electrochemical Engineering course where students ran MATLAB simulations of relevant models chosen from the electrochemistry literature. As part of the Energy Conversion and Storage course that was offered last Fall (and is being offered now), I helped develop the lab component consisting of hands-on fuel cell, electrolyzer, and battery experiments along with their attendant lab manuals and instructional materials.

During my PhD program, I served as a Teaching Assistant for 7 courses including thermodynamics, transport phenomena, undergraduate laboratory and electives in energy technology. The experience of assisting in the teaching of thermodynamics as an introductory first course, an intermediate course for 1st year master's students and as an advanced course for PhD students provided invaluable insights into the nuances of balancing depth and clarity without sacrificing technical accuracy. In this context, a particularly instructive experience was in observing and assisting Prof. Jai Prakash in his use of the top-down approach of Smith and Van Ness[3] for introducing thermodynamics to undergraduates while tying that to the first principles, postulatory approach of Callen[4] and Schieber[5] when teaching the advanced thermodynamics course to graduate students.

Anticipated contributions- Courses where I can readily leverage my experience to create opportunities for experiential learning include Chemical Reaction Engineering and Thermodynamics. In these two courses, I aim to create practical modules wherein students

reinforce and apply the concepts they learn over the semester culminating in a final project synthesizing knowledge from all the modules. I will endeavor to adopt a first principles approach to reaction engineering and thermodynamics, adopting the textbook of Aris[6] and Schieber[5] respectively, while developing practical problems to illustrate the real-life applicability of this mathematical approach. Further, I look forward to developing and/or teaching elective courses on Electrochemical Engineering and Renewable Energy Technologies. I will develop instructional lab components for these courses that will reinforce the concepts and can also be used for student outreach programs. Additionally, my background in chemical engineering has prepared me to serve as an instructor for any of the ChE core courses at all levels.

Outreach- In addition to classroom instruction, I have found presenting my research and (chemical engineering in general) to non-academic audiences to be highly educational to me. These presentations have allowed me to streamline and refocus ideas, eliminate the unnecessary jargon and iterate to the simplest possible way to convey a particular concept.

I have represented my postdoc lab and presented our work in poster form at the St. Louis Art Museum in an event highlighting WUSTL's environmental efforts. I have coordinated and personally led events highlighting STEM opportunities for high school girls as part of the Women in STEM day at WUSTL. The challenge of conveying a sense of belonging in the STEM fields to underrepresented groups adds a new dimension to my instructional efforts. Presenting my work in a broader social context, especially to underrepresented groups, in a welcoming and inclusive manner is a passion of mine and I look forward to aiding or perhaps playing a leadership role in such efforts in my new academic home.

I will actively recruit high-school students as summer interns in my lab, both as a part of my inclusive outreach efforts and to provide beginning graduate students a mentorship opportunity.

Research group mentoring- Graduate students and postdoctoral fellows will play a critical part in the collective success of my lab's research enterprise. More than any skill or technique, I will seek to impart to my group members the tools needed for lifelong learning.

Safety and ethical research practices will be a critical component of the lab environment. I will organize a monthly rotating roster of lab safety officers to monitor safe practices in research, environmentally conscious chemical disposal and general lab hygiene. I will identify on-campus ethical research training opportunities or develop my own curriculum to educate my students on best practices for data collection and retention, statistical data analysis concepts and in publishing.

References:

(1) Brent, R.; Felder, R. M. *Chem. Eng. Educ.* **1998**, *32* (3), 46.
(2) Felder, R.; Silverman, L. *Eng. Educ.* **1988**, *78* (June), 674.
(3) Smith, J. M.; Ness, H. Van; Abbott, M. M. 2005, p 817.
(4) Callen, H. B. *Thermodynamics and an Introduction to Thermostatistics*, 2nd ed.; Wiley, 1985.
(5) de Pablo, Juan J.; Schieber, J. D. *Molecular Engineering Thermodynamics*, 1st ed.; Cambridge University Press, 2014.
(6) Aris, R. *Elementary Chemical Reactor Analysis*; Butterworth-Heinemann, 1989.