PURDUE | Davidson School of Chemical Engineering
UNIVERSITY. | COLLEGE OF ENGINEERING

To: The Engineering Faculty
From: Charles D. Davidson School of Chemical Engineering
Re: New Concentration in Data Science in Chemical Engineering

The Charles D. Davidson School of Chemical Engineering has approved the following addition of the new *Data Science in Chemical Engineering* concentration to the Chemical Engineering Professional Master's Program. This action is now submitted to the Engineering Faculty with recommendation for approval.

Concentration Description

The mission of the Professional Master's Concentrations in Chemical Engineering is to provide advanced technical education combined with the development of professional management skills in the key areas of chemical engineering related to industry sectors of regional, national, and international importance. The concentration in data science will provide skills in analysis of structured and unstructured data sets, big and small, associated with the optimal design and operation of modern chemical processes.

Justification

As members of our industrial advisory council discussed in our recent symposium on the subject, the inexorable permeation of so-called "big data" technologies into related industries, including chemicals, energy, materials, pharmaceuticals, process safety, etc. – all of which require significant domain expertise – will necessitate chemical engineers who can connect data driven discovery to knowledge creation. This sentiment, echoed in a discussion on integrating data science subject matter into chemical engineering programs at last year's AIChE Annual Meeting, means modern chemical engineers will need to understand the principles of data science which, beyond traditional mathematical and statistical modelling, include programming, data processing, statistical inference, machine learning, data visualization, digital security, and other subjects not historically covered in our curriculum. In an effort to meet this burgeoning demand, this concentration is designed to familiarize our students with a wide array of these topics in the context of modern chemical engineering problems, thereby enhancing the core chemical engineering competencies currently provided by the PMP. This new concentration is likely to be attractive to a much wider range of potential students.

Please see attached documents for more information about target audiences and a detailed plan of study.

Dr. Sangtae Kim
Distinguished Professor and Head
Davidson School of Chemical Engineering

Professional Master's Concentration in Chemical Engineering – Data Science in Chemical Engineering

The Mission of the Professional Master's Concentrations in Chemical Engineering is to provide advanced technical education combined with development of professional management skills in key areas of chemical engineering related to industry sectors of regional, national, and international importance.

The Professional Master's in Chemical Engineering will be a series of new concentrations under the existing coursework Master's degree. There will be a common structure for all such concentrations.

1. All concentrations require:
   a. Two core ChE courses
   b. Three courses that are considered core for that concentration.
   c. Three courses related to professional management.
   d. 6 credit hours of a directed research project course.
2. Students without a Bachelor's in Chemical Engineering or equivalent may be required to take additional courses.

Of the total 30 credit hours required for the degree, a minimum of 15 credit hours must be with a CHE prefix.

There are three target audiences for these new concentrations.
1. Existing Purdue BS students who upon graduation, wish to take further study, improve their skills and increase their employability in key industry sectors
2. International and domestic students at other institutions who, upon graduation, wish to take the Professional Master's concentration at Purdue to gain a professional degree from a top U.S. Engineering School to improve their skills and increase their employability in key industry sectors.
3. Practicing professional engineers with the target industry sectors wishing to improve their skills and improve their career development pathways.

Students from target audiences 1 and 2 are likely to be full-time students, while practicing professional engineers are likely to enroll part time. The program can be completed in one calendar year of full-time study (including a summer semester).

Currently, the MS (non-thesis) in Chemical Engineering emphasizes technical courses only and does not have specialized concentrations. The new concentrations are likely to be attractive to a much wider range of potential students. The new Professional Master's concentrations do not have a thesis and do not articulate to the PhD program.

For the **Professional Master's Concentration in Chemical Engineering – Data Science in Chemical Engineering** the following faculty are currently involved.

Faculty Coordinator: Brett Savoie (Assistant Professor of Chemical Engineering)

Participating faculty: Sangtae Kim (Jay and Cynthia Ihlenfeld Head of Chemical Engineering and Distinguished Professor), Gintaras Reklaitis (Burton and Kathryn Gedge Distinguished Professor of Chemical Engineering) and Curtis P. Martin (Visiting Assistant Professor of Chemical Engineering)

We expect the number of students enrolled to be 5-10 in the first year and rise to ~20-30 within three years of first offering the concentration.

Professional Master's Concentration in Chemical Engineering – Data Science in Chemical Engineering
Learning Outcomes: The graduate will be able to:
1. Demonstrate an advanced grasp of theoretical and experimental aspects related to topics in data science and how they apply to chemical engineering.
2. Write and develop programs using general-purpose programming languages.
3. Employ various computational algorithms and resources which enable the student to effectively find, store, comprehend, apply and visualize data.
4. Observe best practices and ethical responsibilities associated with working with large volumes of sensitive data.
5. Communicate with and provide discipline-specific context to data scientists employed in industry.
6. Manage and lead chemical engineers and data scientists alike.

Core Curriculum (All Concentrations): At least 6 credit hours from the following list:
- CHE 61000 Advanced Chemical Engineering Thermodynamics
- CHE 54000 Transport Phenomena **OR** CHE 62000 Advanced Transport Phenomena I
- CHE 63000 Applied Mathematics For Chemical Engineers **OR** CHE 69700 Statistical Methods in Chemical Engineering *(permanent course # pending)*
- CHE 54300 Polymerization Reaction Engineering And Reactor Analysis **OR** CHE 66000 Chemical Reaction Engineering

Concentration Courses: At least 9 credit hours from the following list*:
- CHE 55500 Computer Integrated Process Operations
- CHE 59700 Data Science in Chemical Engineering (permanent course # pending)
- CHE 63300 Probabilistic Methods in Chemical Engineering
- CS 57800 Statistical Machine Learning
- PHIL 58000 Ethics of Data Science

Management Courses: At least 9 credits of management courses from the following list*:
- MGMT 61000 Financial Marketing
- MGMT 62000 Marketing Management
- MGMT 65000 Strategic Management
- MGMT 66000 Operations Management

*Courses not on this list will be considered by the Professional Master's Committee, including the Director of the Professional Master's Program, and added to the list as appropriate.