Doctor of Philosophy in Chemical and Petroleum Engineering

Chemical and Petroleum Engineering

Chemical engineering has grown out of a combination of chemistry and engineering associated with industrial processes. Today, it comprises knowledge used in processes that change the physical state or composition of materials. Chemical engineers, across all industries, hold key roles in the design, development, production, and purification of materials considered essential to human life and well-being, such as food products, fuels and lubricants, pharmaceuticals, fertilizers, synthetic fibers, microelectronic components, plastics, and more. Chemical engineers are involved in reducing the use of energy to make products in a safe and sustainable way and minimizing environmental impacts. Areas of study in the Chemical Engineering Department include (but are not limited to):

Catalysis (hetero and homogeneous), Reaction Kinetics, Fuel Cells & Energy Storage, Biofuels, Interfacial Phenomena, Biomedical, Drug Delivery, Electrocatalysis, and Photoelectrocatalysis.

Petroleum engineering is concerned with the drilling, recovery, production, and distribution of petroleum and natural gas. Petroleum engineers use knowledge of fluid and rock properties in subsurface environments to produce oil and gas safely and economically. At the University of Kansas, the focus is on reservoir engineering and improving production from oil and gas reservoirs. Reservoir engineers use geological detection with computerized mathematical analysis to produce raw materials. New areas of research are focused on unconventional reservoirs and Net Carbon Zero geoenergy using AI and data mining for intelligent and sustainable petroleum engineering. Areas of study in the Petroleum Engineering Department include (but are not limited to):

Data Mining and Artificial Intelligence Supported Reservoir Engineering, Hydraulic fracturing and acidizing of unconventional reservoirs, Characterization and simulation of tight oil and gas reservoirs, Oilfield nanoparticles, CO_2 enhanced oil recovery and CO_2 storage, and Phase behavior of reservoir fluids.

Standard Admission Requirements for all Graduate Programs

- All applicants must meet the requirements outlined in the Admission to Graduate Study (https://policy.ku.edu/graduate-studies/admission-to-graduate-study/) policy.
- Bachelor's degree: A copy of official transcripts showing proof of a bachelor's degree (and any post-bachelor's coursework or degrees) from a regionally accredited institution, or a foreign university with equivalent bachelor's degree requirements is required.
- English proficiency: Proof of English proficiency (https://gradapply.ku.edu/english-requirements/) for non-native or non-native-like English speakers is required. There are two bands of English proficiency, including Admission and Full proficiency. For applicants to online programs, Full proficiency is required.

Ph.D. Admission Requirements to the Department of Chemical & Petroleum Engineering

To qualify for study in any of the graduate programs in the Department of Chemical & Petroleum Engineering, a student generally must have earned an accredited bachelor's degree and/or master's degree in chemical or petroleum engineering. However, a student with good preparation in another engineering discipline or a related field, such as chemistry, physics, geology, or other engineering disciplines may qualify by taking the appropriate prerequisite undergraduate courses. These courses are determined on a case-by-case basis by the Department's Graduate Admissions Committee/Director.

Application Deadlines

- Fall Priority Deadline: January 5; final deadline March 1
- Spring Priority Deadline: October 1

All application materials must be submitted by the final deadlines, March 1 (Fall semester admission) and October 1 (Spring semester admission). All admitted students are considered for any funding opportunities for which they qualify. See our Graduate Admissions (https://cpe.ku.edu/graduate-admissions/) page or the Graduate Studies website (http://www.graduate.ku.edu/) for the application procedure and fees.

Application Materials

- Statement of Purpose
- Resume or Curriculum Vitae
- Three letters of recommendation
- TOEFL, PTE, or IELTS-Academic scores (non-native English speakers only)

The following documents are required only after a student has been admitted:

- Financial Statement (International students only if no department funding offer)
- One (1) official transcript sent directly from the applicant's university to the University of Kansas

*TOEFL Scores

- Institution Code – 6871
- Program Code – 64

IELTS Scores

- Email an electronic copy to cpegrad@ku.edu.

*As of October 2020, GRE scores are no longer required as part of the application process.

Students admitted with baccalaureate degrees in chemical or petroleum engineering enroll in the graduate core courses listed in our Graduate Program Manual (https://cpe.ku.edu/degrees/). Students with degrees in other branches of engineering or in mathematics, chemistry, physics, or other sciences must take undergraduate courses to provide the necessary background for the graduate level courses and are admitted provisionally.

See undergraduate prerequisite courses listed in the M.S. Degree Requirements section. Students who have already completed a M.S. degree will have the total number of hours reduced on a case-by-case basis, with the approval of the Graduate Standards Committee, and based on individual background and course history. No credits will transfer in at the Doctoral level; however, the 60 total credit hour requirement can be reduced to as low as 45 credit hours.

All graduate applications must be submitted online (http://www.graduate.ku.edu/).

Regular Status

For admission to regular status, the student must have an undergraduate grade point average of at least B (3.0 on a 4.0 scale). For students whose undergraduate GPA is below 3.0, admission on probational status will be considered on a case-by-case basis. Graduate Record Examination (GRE) scores are required.

Foreign Student English Proficiency

To find the most up-to-date information about the University's English Proficiency Requirements, visit the Graduate Studies Webpage (https://gradapply.ku.edu/english-requirements/).

Visit Us

Graduate program staff can assist prospective students in determining the fit between the student and the program. Staff can facilitate a campus visit. If you would like to schedule a visit, there are two main options:

The first, and most preferred, entails simply applying for admission to the program. All prospective students are welcome to attend our Open House in mid-October or mid March. Eligible admitted students may be invited to participate in Campus Visit Days in February or March (prior to the fall semester of your intended matriculation). These organized visitation opportunities will allow you to gather a great deal of first-hand information which we hope will help you in making a final decision about whether to attend KU.

The second option is making arrangements to visit us on your own, outside of organized events. With early notification, we will do our best to work with you to provide information and schedule appointments with faculty when possible.

Contact Information

Please contact the CPE Graduate Program Coordinator, cpeGrad@ku.edu or (785) 864-2900, if you would like to schedule a campus visit, or have questions about the program or the application process.

The University of Kansas
CPE Graduate Program
4132 Learned Hall
1530 W. 15th Street
Lawrence, KS 66045

Ph.D. Degree Requirements

One of the goals of the department is to develop quality Ph.D. researchers who are well prepared for vocational and personal success. This policy sets forth a balanced program to develop and evaluate students in an efficient and fair manner. Equal consideration is given to the academic and the research ability, as both areas are required for success in industry or academia.

The Ph.D. graduate program typically consists of the completion of 60 credit hours beyond the B.S. degree or 45 credit hours beyond the M.S. degree. For more details about the courses and general timeline, see our Graduate Program Manual (https://cpe.ku.edu/resources-students-graduate/).

An advisory committee of 5 or more members is formed for each Ph.D. aspirant: at least 3 tenure / tenure track faculty from the department and 1 member from outside the department at KU are required. The student's research advisor normally serves as the committee chair. See the Graduate Catalog for doctoral committee composition requirements. The committee works with the aspirant to develop a plan of study and monitors the progress of the student throughout the remainder of the Ph.D. program.

A plan of study must be approved by the student's advisor, the examining advisory committee, and the departmental Graduate Studies director by the end of the first semester. Before scheduling the comprehensive examination, the aspirant must satisfy residency, basic research skills, and the responsible scholarship requirements.

The research skill requirement provides the aspirant with a research skill distinct from, but strongly supportive of, the dissertation research. Work done to fulfill this requirement should involve study in an area complementary to the dissertation research and should enhance the student's ability to carry out the research.

Preliminary Examination of Research - B.S. to Ph.D. (Exception students who earned a thesis-based master's degree in chemical engineering from another accredited institution are exempt from this exam.)

This exam is an important milestone for graduate students who do not have a prior research master's degree, on their way to becoming a Doctoral Candidate in the Chemical & Petroleum Engineering department. Other departments call this the Qualifier or Qualifying exam. The CPE Preliminary Exam is given to determine the student's aptitudes for 1) Independent, original critical thinking; 2) Planning and organizing a research project; 3) Use of previous work and background literature to demonstrate a) Understanding of the planned research within the scope of the larger project and b) Ability to conduct that research; 4) Application of fundamental theory (e.g. equations) to the proposed work; 5) Effective communication of technical work.

Students taking this exam will have a) completed three C&PE Core classes with a 3.0 GPA or higher without having earned more than one 'C' or lower grade or b) have met the same criteria for equivalent courses during their Master's degree program at another accredited university and maintained a KU cumulative GPA above 3.0.

The two main components of this exam are the Written Report and the Oral Presentation. The topic for the exam will be a proposal of the research the student plans on performing for their final dissertation. The written portion should utilize standard formatting: 12pt font, 3-5 pages, single line spaced, 1-inch margins, a title, and name and date on top-left corner. Once the written portion has been submitted to the research advisor, it will be time to schedule the oral presentation. Students will work with their advisor, the graduate director, and the graduate program

coordinator to schedule the presentation to ensure all department procedures and policies are correctly followed. The Oral presentation should take between 15 to 20 minutes. This exam in general is an excellent opportunity to make sure your full committee is arranged and for them to give you initial feedback as your dissertation writing begins in earnest.

Successful completion of the Preliminary Exam of Research admits the student into the Ph.D. program and earns the student 'Ph.D. Aspirant' status.

Comprehensive Examination

The Ph.D. aspirant will take the comprehensive examination after completion of all coursework. Before this exam can be taken, there are three additional requirements set by the School of Engineering that students need to meet. These are:

1. **Residency Requirements:** Must have been accumulated 18 credit hours from enrollment.
2. **Research Skills**: This requirement is satisfied by a letter from the student's advisor clearly explaining how the student has met the research skills.
3. **Responsible Scholarship:** All students must complete at least 3 credit hours of CPE 800 before scheduling the comprehensive exam.

The purpose of this examination to assess students' ability to conduct independent research, related to their dissertation topic. The exam itself consists of two parts: a written report/proposal and an oral examination based on, but not limited to, the research proposal. The written report/proposal should have the following content:

- Current progress (40%): Students describe their current dissertation project, and the progress they have made thus far. This section should include a background, motivation and research aims that have been completed/are in progress.
- Proposed research (40%): Students build on their current results to propose a new direction or independent research that will be performed as part of their final dissertation. The research objectives described should be those that will be completed as part of the student's dissertation research.
- Future direction (20%): Students describe logical extensions of the current research described in the dissertation. This section can be considered as part of the future directions chapter of the final dissertation.

The written document must conform to the following requirements: (adapted from the NSF PAPPG guidelines)

1. Page length: 15 pages.
2. Margins, in all directions, must be at least an inch.
3. Paper size must be no larger than standard letter paper size (8½ by 11 or 11 by 8½).
4. No more than six lines of text within a vertical space of one inch.
5. Use one of the following fonts identified below:

   Arial (not Arial Narrow), Courier New, or Palatino Linotype at a font size of 10 points or larger; Times New Roman at a font size of 11 points or larger; or Computer Modern family of fonts at a font size of 11 points or larger.

   A font size of less than 10 points may be used for mathematical formulas or equations, figures, tables, or diagram captions and when using a Symbol font to insert Greek letters or special characters. Other fonts not specified above, such as Cambria Math, may be used for mathematical formulas, equations, or when inserting Greek letters or special characters.

A student must pass both parts of the examination. Failure of either part constitutes an unsatisfactory grade on the entire examination. An aspirant who receives a grade of Unsatisfactory may repeat the examination upon the recommendation of the examining committee, but under no circumstances may it be taken more than twice. The examination may not be repeated until at least 90 days have elapsed since the unsuccessful attempt. To prepare the aspirant for the comprehensive examination, the advisory committee may require enrollment in C&PE 902 (Preparation for the Ph.D. Comprehensive Examination) during the first year of the Ph.D. program. On receipt of a grade of Honors or Satisfactory on the comprehensive examination, the aspirant is admitted to candidacy for the degree of Doctor of Philosophy. {For more about the School of Engineering comprehensive exam requirements and full university policy wording: https://policy.ku.edu/graduate-studies/doctoral-oral-exams.

Successful completion of the Comprehensive Exam earns the student Doctoral Candidate Status

Ph.D. Dissertation and Final Oral Examination

The doctoral dissertation, based on independent research conducted by the candidate, constitutes the final phase of the doctoral work and must be completed within the prescribed time constraints. Upon acceptance of the dissertation by the advisory committee, the candidate defends the dissertation in a final oral examination. The examining committee consists of at least 5 persons, including the advisory committee members and at least 1 person from outside the department.

MS to PhD Program

If a student obtains their MS degree in Chemical or Petroleum Engineering from the University of Kansas and plans to continue on into the doctoral program, then the GPA from the core courses will be used as the basis for entering the PhD program. If the student obtained their MS degree in Chemical or Petroleum Engineering (or very closely related fields) from another university, then the student's MS course work is evaluated by:

The Graduate Standards Committee (GSC) will determine if any of their MS core courses will count toward the requirements to become a PhD aspirant. A minimum of 45 credits must be completed at KU for Ph.D. degree completion.

Course Requirements:

Core Courses: 15 credit hours (or equivalent as approved by GSC)

Elective Courses (15 hours): 3 CPE Courses; 2 courses from outside CPE (7XX or greater)

Graduate Seminar (C&PE 800): Every semester while in residence

Research: 30-34 hours

- 3.0 Overall GPA.
- Only one C may be obtained. If more than one C is obtained, the student will be placed on departmental probation.
- Preliminary Examination: See Policy and Rubric on departmental website.

BS to PhD Program (fast track PhD)

Course Requirements: Minimum of 60 total credit hours

Core Courses: See list of Graduate Core Courses in the MS Degree section

Elective Courses (15 hours): 3 CPE Courses; 2 from outside CPE (7XX or greater)

Graduate Seminar: C&PE 800 Every semester while in residence

Research: 30-34 hours

- 3.0 overall GPA required in all courses.
- Only one C may be permitted.
- Preliminary Examination: See Policy and Rubric on departmental website.

At the completion of this program, students will be able to:

- Effectively communicate advanced chemical concepts in writing and orally at a professional level.
- Acquire new information, to learn new concepts, to build new skills, and to engage in life-long learning.
- Conduct original work in the Chemical Engineering. OR
  The ability to complete a 3-hour special project in Chemical Engineering.