

**Department of
Chemical and Petroleum Engineering**

**Graduate
Program
Manual**

{August 2015 Proposed Revision}

Welcome to the Chemical and Petroleum Engineering Graduate Program

The Chemical and Petroleum Engineering (C&PE) Graduate Program at The University of Kansas provides an in-depth, academic understanding of chemical and petroleum engineering for students who plan to have careers in academia, research and development, or in their related professional industries. Our department offers a Master's Degree (MS) in either chemical or petroleum engineering and a Doctorate of Philosophy (PhD) in chemical and petroleum engineering.

In the Master's programs, the primary emphasis is on formal course work in engineering and related subjects. Students take a sequence of core courses in heat, mass and momentum transport, thermodynamics, reaction kinetics, applied mathematics, reservoir engineering, and petroleum recovery.

In the Doctoral program, the focus is on an independent research project in a significant engineering area. Specific PhD course work will revolve around the student's chosen area of specialization, which reflects the combined research interests of the student and faculty. In addition to specialized courses in the department, advanced courses in mathematics and computer science, life sciences, physical sciences, and other branches of engineering may be used to prepare the PhD student for their research project.

The following information and guidelines include departmental requirements and are intended to assist each student, and their advisory committee, in preparing a Plan of Study. The Plan of Study is an individuated, detailed path to a graduate degree.

Chemical and Petroleum Engineering Graduate Courses

Prerequisite Courses

<u>For the Chemical Engineering Degree:</u>	<u>For the Petroleum Engineering Degree:</u>
C&PE 511: Momentum Transfer	C&PE 511: Momentum Transfer
C&PE 512: Chemical Engineering Thermodynamics	C&PE 521: Heat Transfer
C&PE 521: Heat Transfer	C&PE 527: Reservoir Engineering II
C&PE 523: Mass Transfer	C&PE 618: Waterflooding
C&PE 524: Kinetics and Reactor Design	A geology course such as Geol 535: Petroleum and Subsurface Geology, is also recommended

Regular Graduate Courses

(Note: Not all classes are offered each semester/year)

C&PE 701*** Methods of Chemical and Petroleum Calculations (3) {Fall Only}

C&PE 710 Subsurface Methods in Formation Evaluation

C&PE 712 Environmental Assessment of Chemical Processes

C&PE 715 {this class changes topics each semester}

C&PE 721* Chemical Engineering Thermodynamics (3) {Fall Only}

C&PE 722* Kinetics and Catalysis (3) {Spring Only}

C&PE 725 Molecular Cell Biology

C&PE 731*** Convective Heat and Momentum Transfer (3) {Fall Only}

C&PE 732* Advanced Transport Phenomena II (3) {Spring Only}

C&PE 751 Basic Rheology (3)

C&PE 752 Tissue Engineering (3)

C&PE 753 Introduction to Electrochemical Engineering

C&PE 754 Biocatalysts

C&PE 755 Introduction to Semiconductor Processing

C&PE 756 Introduction to Biomedical Engineering

C&PE 765 Corrosion Engineering (3)

C&PE 771** Advanced Reservoir Engineering (3) {Spring Only}

C&PE 778 Applied Optimization Methods (3)

C&PE 790 Introduction to Flow in Porus Media

C&PE 795** Enhanced Petroleum Recovery (3) {Fall Only}

C&PE 798 Phase Equilibrium

C&PE 800 Seminar (.5-1)

C&PE 802 CEBC Colloquium (.5-1)

C&PE 803 MS Research (.5-1)

C&PE 804 Petroleum Management Seminar (1)

C&PE 825 Graduate Problems

C&PE 902 Preparation for PhD Comprehensive Exam (3)

C&PE 904 PhD Research (.5-1)

C&PE 910 Industrial Development of Catalytic Processes (3)

C&PE 911 Industrial Practicum (1-3)

C&PE 929 Advanced Topics in Chemical and Petroleum Engineering (1-4)

C&PE 933 Heat and Mass Transport with Phase Change

C&PE 936 Industrial Separation Processes (3)

C&PE 937 Applied Rheology

C&PE 939 Advanced Topics in the Transport Phenomena: __

C&PE 940 Data Analysis in Engineering and Natural Sciences (3)

* Chemical Engineering Core Course

**Petroleum Engineering Core Course

***Both ChemE and PetroE Core Course

GRADUATE PROGRAM OVERVIEW

	Item	When	Responsibility
	MS: Items 1–3 & 8-10 PhD: All Items 1-10		
1	Advisor Selection	During first semester	Student
	Attend faculty presentations, meet with faculty, and submit selections		
2	Selection of Committee Members	End of second semester	Research Advisor
	MS: 3 members, no special requirements		
	PhD: 5 members, at least 1 must be from another department		
3	Plan of Study	End of second semester	Research Advisor
	Meet with Advisor to select courses		
4	Preliminary Research Exam	End of first calendar year	Research Advisor
	For Direct PhD students Only		
5	Residency Requirement for PhD	Before completing the comprehensive exam	Student
	At least two semesters as full time students at KU		
6	Responsible Scholarship and Research Skills Requirement	After the relevant courses are completed and as a requirement for taking the comprehensive exam	Research Advisor
	Responsible Scholarship: Must complete a minimum of 1 credit hour of CPE 800		
	Research Skills: A letter send graduate studies from your Advisor explaining a coherent research theme		
7	Comprehensive Examination	After all core course work is completed	Thesis Committee
	(a) Written Part: Research problem presented in a proposal form (b) Oral Part: Only after Written Part is approved.	Note: The Research Advisor will prepare the problem. Exam must be completed at least 5 months before graduation	
8	Final Defense of PhD Dissertation or Master's Thesis	When the advisor and student decide it is ready	Thesis Committee
9	Submit Dissertation or Thesis	When all corrections are made	Student
10	Graduate!!	When all above items are complete	Student

MS Degree Requirements

For an MS in Chemical Engineering, the undergraduate prerequisite courses are: C&PE 511 Momentum Transfer; C&PE 512 Chemical Engineering Thermodynamics; C&PE 521 Heat Transfer; C&PE 523 Mass Transfer; C&PE 524 Kinetics and Reactor Design.

For an MS in Petroleum Engineering, the undergraduate prerequisite courses are: C&PE 511 Momentum Transfer; C&PE 521 Heat Transfer; C&PE 527 Reservoir Engineering II; C&PE 618 Waterflooding; A geology course such as GEOL 535 : Petroleum and Subsurface Geology, is also recommended

Plan of Study. Before the end of the second semester each student on the MS track, with the help of their advisor, should create and submit a Plan of Study to the School of Engineering via their website: <https://gradplan.engr.ku.edu/> The Plan of Study is a tool which is used to help keep you on track throughout the degree program. When you create your plan you will decide your estimated term of graduation and it will help you pace your class choices. Depending on a student's academic background and proposed Plan of Study, additional undergraduate prerequisite courses may be required. Up to 3 credit hours of the undergraduate prerequisite courses (numbers 500 or above) may be counted toward the MS degree as elective hours.

The MS program requires a minimum of 30 credit hours including the Graduate Core (15 hours) and submission and successful oral defense of a research thesis for 6 hours of credit. Students in this program may be considered for research assistantships, teaching assistantships, and fellowships. A 3.0 grade-point average at the end of each semester of residence is required to maintain regular student status and for graduation. Only the first 4 hours of enrollment in C&PE 803 meet degree requirements.

The following tables represent typical plans of study that might be established by a student and advisor. Only rarely are exceptions in C&PE course work allowed. It is recommended that part of the elective hours be from other departments. For petroleum engineering, if a student has not completed an advanced-level, reservoir-related course in geology as an undergraduate, such a course must be taken as one of the electives. GEOL 535 Petroleum and Subsurface Geology is recommended.

MS in Chemical Engineering

ChE Graduate Core Courses (15 hours)

C&PE 701 Methods of Chemical and Petroleum Calculations	3
C&PE 721 Chemical Engineering Thermodynamics	3
C&PE 722 Kinetics and Catalysis	3
C&PE 731 Convective Heat and Momentum Transfer	3
C&PE 732 Advanced Transport Phenomena II	3

Electives (6 hours) 6

Research (9 hours)

C&PE 800 Seminar	3
C&PE 803 Research	6

Thesis

Oral Examination (presentation of the thesis to your committee)

MS in Petroleum Engineering

PE Graduate Core Courses (12 hours)

C&PE 701 Methods of Chemical and Petroleum Calculations	3
C&PE 731 Convective Heat and Momentum Transfer	3
C&PE 771 Advanced Reservoir Engineering	3
C&PE 795 Enhanced Petroleum Recovery	3

Electives (9 hours) 9

Research (9 hours)

C&PE 800 Seminar	3
C&PE 803 Research	6

Thesis

Oral Examination (presentation of the thesis to your committee)

Thesis Presentation: All Master's Degree seeking students will form a committee of no less than three faculty members to serve on their thesis committee, their research advisor normally serves as chair of this committee. For further instructions on this process, see the *Graduation* section below.

Graduation: Once the bulk of the coursework has been completed, The School of Engineering has several checklists and information available to help students [prepare for graduation](#), detailed information about [applying for graduation](#), and information about the [graduation ceremony](#) itself.

PhD Degree Requirements

Admission. Admitted students usually complete an MS in Chemical or Petroleum Engineering before they pursue the PhD. Students admitted with a completed MS degree will take the Graduate Core courses as needed based on their previous coursework and training, as specified by the Graduate Standards Committee.

An MS student may apply for change of status to PhD aspirant if the student a) has achieved a grade point average (GPA) of 3.2 or higher in the Graduate Core, b) has earned no 'C' grades in the Graduate Core, and c) has passed the Preliminary Exam of Research, or 'prelim'. These criteria are evaluated during the third semester of residence by the graduate faculty of the department upon recommendation by the GSC. Students not meeting these criteria will complete the MS degree before applying to the PhD program.

In some cases, a student may be admitted directly to the PhD program without an MS degree. Such admission normally is granted only when the applicant has clearly demonstrated exceptional performance in an undergraduate program and in any graduate work. Students who are admitted to the PhD degree program and who do not complete an MS degree in chemical and petroleum engineering

generally must satisfy the same GPA and prelim requirements for PhD aspirant status as students admitted to the MS program, or will complete the MS degree before readmission to the PhD program.

Credit hours for the PhD degree normally consist of 15 credit hours of courses beyond the Graduate Core and 30-34 credit hours of research work as specified in the following table:

PhD in Chemical & Petroleum Engineering

PhD Courses (30 hours)

C&PE Core Courses (*5 courses/15 hrs for Chem E focus or 4 courses/12 hrs for Petro E focus*)

C&PE inside electives (*3 courses/9 hrs for ChemE focus or 4 courses/12 hrs for Petro E focus*)

Outside electives (700+ level/ *2 courses = 6 hrs*)

C&PE Research (30+ hours)

C&PE 800 Seminar

C&PE 902 Preparation for the PhD Comprehensive Examination (optional)

C&PE 904 Research

The following guidelines apply in selection of course work:

1. Enrollment in the C&PE graduate seminar (C&PE 800) every semester in residence, usually for 1.0 credit. Students who are required to attend another seminar to satisfy a fellowship or research program requirement may enroll in both seminars for 0.5 credit hour each. Any schedule conflicts should be discussed with both seminar coordinators.
2. Enrollment for a minimum of three graduate-level courses in C&PE. These do not include C&PE 902 (Preparation for the PhD Comprehensive Examination) or any graduate seminars. All courses in the C&PE department that count toward the PhD degree must be numbered 700 or above.
3. Enrollment for at least two courses (normally 6 hours) numbered 700 or above outside the department.
4. For non-KU students, the KU equivalents of courses that have already been counted toward another degree do not count toward the PhD degree.
5. A minimum of 1 credit hour of C&PE 800 must be completed by all PhD students prior to the comprehensive exam.

These guidelines are to aid in the preparation of the Plan of Study for most PhD students. However, there may be exceptions arising from the student's academic background and the type of research, wherein the selection of courses may not adhere to these guidelines. In such exceptional cases, the student's PhD Plan of Study must have the approval of the GSC.

Detailed Explanations

Plan of Study. Before the end of the second semester each student on the PhD track, with the help of your advisor, should create and submit a ***Plan of Study*** to the School of Engineering office via their website: <https://gradplan.engr.ku.edu/> The Plan of Study is a tool which is used to help keep you on track throughout the degree program. When you create your plan you will decide your estimated term of graduation and it will help you pace your class choices.

Preliminary Exam of Research.

{Note: This policy is under review as of October 2015- See Graduate Director or Program Assistant with any questions}

The prelim is administered to C&PE graduate students requesting admission to the C&PE Ph.D. program without earning the M.S. degree. Students taking this exam will have a) completed the Graduate Core courses at KU (five in ChE, four in PE concentration) with a 3.2 GPA or higher for ChE, or 3.25 GPA or higher for PE, and no 'C' grades; and b) have worked with a C&PE advisor at least two semesters on a single research project. Successful completion of the prelim exam admits the student into the Ph.D. program and gives 'Ph.D. aspirant' status.

The prelim is given to determine the student's aptitudes for:

- 1) Independent, original critical thinking**
- 2) Planning and organizing a research program**
- 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**

Timeline:

Students take the prelim after their first calendar year in the C&PE graduate program (usually in early September) as set by the research advisor in cooperation with the Graduate Advisor. Prelims for each entering class will usually be scheduled in a single two week period. The research advisor gives the student at least one month advance notice of the exam date. The student and research advisor may request an extension of up to one year from the Graduate Standards Committee (GSC) if they agree the student's communication ability is not yet adequate or if non-academic issues exist (e.g. illness).

Exam:

The prelim consists of a written report (5 pages maximum); oral presentation (15 min maximum); questions by the examining committee (25 min maximum). The written and oral portions are prepared by the student only, with no review or editing by the research advisor or any other person. The written report is submitted to the committee one week before the oral exam. Questions asked by the committee will be directed towards determining the five aptitudes listed above. As this is not a mandated activity of the University or School of Engineering, the Graduate Advisor will be responsible for its execution.

Committee Composition:

The examining committee consists of the members of the student's thesis committee plus a member of the C&PE faculty not already on the student's research committee. The external member is appointed by the GSC and approved by the student's research advisor. Ideally, that faculty member serves as the external on all prelims conducted at the same time to maintain consistency.

Evaluation:

Evidence of each aptitude will be measured by the composite performance on the written, oral and question portions of the exam. Each aptitude will be graded on a scale of 1 to 3, with definitions of each level similar to ABET evaluation of skills. Specifically,

grade of 1 = Does not demonstrate the aptitude

grade of 2 = Shows demonstrable evidence of acquiring the aptitude

grade of 3 = Shows ability to utilize aptitude to further research goals

To pass the prelim, the student must achieve a score of 2.0 or higher on all five aptitudes. The committee assessment is the average of the individual committee member scores on each criterion, and will be rounded to the nearest 0.05. Thus an average score of 1.974 would be rounded to 1.95 (failing), and a score of 1.976 would be rounded to 2.00 (passing). The evaluation will be recorded on the single sheet Prelim Evaluation Form [sample on page following this document] and signed by the advisor. All prelim evaluation forms will be submitted to the GSC and the external prelim committee member. Following approval and signature by that group, copies are made for the advisor and the student within two weeks of exam completion. The original form is retained in the student's academic file. Any required remedial action will be taken within the same semester.

Outcomes:

PASS, PASS with Restriction [PWR] (specific deficiency -- one aptitude score is below 2.0); FAIL (two or more scores below 2.0). The PWR status must be corrected by actions set and documented by the examining committee within the same academic semester. Remedial action taken for PWR status will be documented on the second page of the Prelim Evaluation Form, and signed/dated by the research advisor. If the deficiency is not corrected and documented, a grade of FAIL is assigned. FAIL status requires the student to retake the prelim within four months of the initial exam. This examination can be repeated once. A second failure automatically transfers the student to the MS degree program.

****** Once a student has been designated a Ph.D. aspirant, monitoring of progress is the responsibility of that student's Ph.D. advisory committee.***

PhD Advisory Committee. An advisory committee of five faculty members is formed for each student once the student has been designated a PhD aspirant. The committee works with the aspirant to develop an appropriate overall Plan of Study and monitors the progress of the student throughout the remainder of the PhD program.

On The Committee are:

- 1- The Chair- usually the student's research advisor
- 2- The Graduate Studies Representative- cannot be from the CPE department and should NOT have a vested interest in the student's research (aka. No Conflict of Interest)
- 3, 4, & 5 - The other 3 members of the committee are typically faculty members in the department

For information, see the policy on [Graduate Faculty appointments](#).

Comprehensive Examination. The aspirant takes the comprehensive examination after completion of all core course work. Before this exam can be taken, there are three additional requirements set by the School of Engineering:

1. **Residency Requirements:** Must have been enrolled full time for at least 2 semesters.
2. **Research Skills:** Per a letter from the student's advisor clearly explaining how they've been met.
3. **Responsible Scholarship:** All students must complete at least 1 credit hour of CPE 800 before scheduling the comprehensive exam.

The examination itself consists of two parts: a written proposal for research and an oral examination based on, but not limited to, the research proposal.

For the research proposal, the student is assigned a topic of current interest to the chemical and/or petroleum engineering profession. This assignment is made by an examining committee consisting of at least five persons, including the advisory committee and at least one person outside the department. The aspirant identifies a research problem within the assigned topic area and prepares a written proposal for research on this problem. Normally, the written proposal must be prepared over a specified time period of 30 consecutive days. Except in unusual circumstances, the problem must be distinctly different from the dissertation problem.

The examining committee evaluates the research proposal upon completion. If the committee judges it satisfactory, the oral examination part of the comprehensive examination is held. The oral examination is based on the research proposal but also may cover areas peripheral to the proposal.

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 PhD Comprehensive Examination) during the first year of the PhD 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: click [HERE](#)

PhD 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 time constraints prescribed by the Graduate School. Upon acceptance of the dissertation by the advisory committee, the candidate defends the dissertation in a final oral examination.

When a final oral defense is being scheduled, all members of your advisory committee should be contacted, and a date and time to present your final research should be set. When the title and abstract are ready and the date and time of the defense are agreed upon, the Graduate Assistant should be

contacted (a minimum of 2 weeks before the Final Defense Date) so the proper paperwork can be processed.

Graduation: Once a student feels they are ready to prepare for graduation, the School of Engineering has several resources available to plan the process step by step, such as a [Degree Checklist](#), a [FAQ](#), a [Preparing for Graduation](#) page (the “detailed instructions (ppt)” is very informative), and information about the [Graduation Ceremony](#).

Chemical & Petroleum Engineering Useful People for Graduate Students:

Department Chair: Prof. Laurence Weatherley

4132F Learned Hall, lweather@ku.edu 864-3553 (ext 4-3553)

Graduate Director: Prof. Kyle Camarda >> recruiting, matching research advisors, pre-arrival issues

4165 Learned Hall, camarda@ku.edu 864-2928 (ext 4-2928)

Office Manager/Accountant: Mrs. Heather Abernathy >> pay issues (both GTA and GRA), travel reimbursements, financial questions

4132G Learned Hall, habernathy@ku.edu 864-4966 (ext 4-4966)

Graduate Assistant: Mrs. Martha Kehr >> manages policies, desk assignments, transcripts, records, deadlines, Plan of Studies, posts exam notices and milestone achievements, and more.

4132A Learned, mkehr@ku.edu 864-2900 (ext 4-2900)

CPE Administrative Associate: Mrs. Cynthia Perez >> manages mailboxes, deliveries, supply orders, conference room scheduling and more.

4132 Learned Hall caperez@ku.edu 864-4965 (ext 4-4965)