

DOCTOR OF PHILOSOPHY IN CHEMICAL ENGINEERING WITH SPECIALIZATION IN ENERGY/ENVIRONMENT/ ECONOMICS (E3)

Students interested in the Ph.D. program in chemical engineering are required to take at least 72 credit hours beyond the B.S. degree requirements, including required chemical engineering core courses for the Ph.D. in Chemical Engineering, CHE 543, and at least five E3 courses (from Groups A and/or B). Registration for approximately 24 credit hours of Ph.D. thesis research in E3 areas of study is also required. Candidates must pass written qualifying and comprehensive examinations and must defend their thesis in an oral examination. The Ph.D. committee for E3 students must include at least one professor with specialization in an energy and sustainability area from outside the student's department. The students are also encouraged to register or attend the interdisciplinary graduate seminar (CHE 593) or general seminars offered in energy and/or sustainability areas by the Wanger Institute for Sustainable Energy Research (WISER).

Curriculum

Code	Title	Credit Hours
Core Courses		(33)
CHE 525	Chemical Reaction Engineering	3
CHE 530	Advanced Process Control	3
or CHE 536	Computational Techniques Engg	
CHE 535	Applctn Math Cheml Engrg	3
CHE 551	Advanced Tnsport Phenomena	3
CHE 553	Advanced Thermodynamics	3
CHE 543	Energy Envir Economics	3
Select five E3 courses from Groups A and/or B		15
Ph.D. Research		(24)
Register for 24 hours of Ph.D. thesis research in E3 areas of study		24

Minimum degree credits required: 72

E3 Courses

See descriptions under the respective department's course listings.

Group A

CHE 503	Thermodynamics	3
CHE 536	Computational Techniques in Engineering	3
CHE 541	Renewable Energy Technologies	3
CHE 542	Fluidization and Gas-Solids Flow Systems	3
CHE 565	Fundamentals of Electrochemistry	3
ECE 550	Power Electronic Dynamics and Control	3
ECE 551	Advanced Power Electronics	3
ECE 552	Adjustable Speed Drives	3
ECE 553	Power System Planning	3
ECE 554	Power System Relaying	3
ECE 555	Power Market Operations	3
ECE 557	Fault-Tolerant Power Systems	3
ECE 558	Power System Reliability	3
ECE 559	High Voltage Power Transmission	3
ECE 560	Power Systems Dynamics and Stability	3
ECE 561	Deregulated Power Systems	3
ECE 562	Power System Transaction Management	3
ECE 563	Computational Intelligence in Engineering	3
ECE 564	Control and Operation of Electric Power Systems	3

MMAE 517	Computational Fluid Dynamics	3
MMAE 520	Advanced Thermodynamics	3
MMAE 522	Nuclear, Fossil-Fuel, and Sustainable Energy Systems	3
MMAE 523	Fundamentals of Power Generation	3
MMAE 524	Fundamentals of Combustion	3
MMAE 525	Fundamentals of Heat Transfer	3
MMAE 526	Conduction and Diffusion	3
MMAE 527	Heat Transfer: Convection and Radiation	3

Group B

CHE 541	Renewable Energy Technologies	3
CHE 560	Statistical Quality and Process Control	3
ENVE 501	Environmental Chemistry	3
ENVE 506	Chemodynamics	3
ENVE 542	Physiochemical Processes in Environmental Engineering	3
ENVE 551	Industrial Waste Treatment	3
ENVE 561	Design of Environmental Engineering Processes	3
ENVE 570	Air Pollution Meteorology	3
ENVE 577	Design of Air Pollution Control Devices	3
ENVE 578	Physical and Chemical Processes for Industrial Gas Cleaning	3
ENVE 580	Hazardous Waste Engineering	3