Paper Science and Engineering (BS)

To see more about what you will learn in this program, visit the Learning Outcomes website (https://apps.oirp.ncsu.edu/pgas/)!

The Paper Science and Engineering curriculum prepares students for careers in the paper industry, which ranks as the fifth-largest manufacturing industry in the United States. Science, engineering, and mathematics form the basis for a multidisciplinary approach to understanding the fundamental aspects of materials science and engineering of these complex renewable materials. Students study the technology and engineering of wood pulping processes, chemical and energy recovery systems, and pulp bleaching. In addition, various papermaking operations, such as refining, sizing, coating, and drying are studied. These topics, along with the chemical and biological modification of wood, papermaking, and the physics of paper based materials form a fundamental set of core courses that all students in the curriculum take.

Two concentrations are available emphasizing the different engineering aspects of pulping and paper making. The Paper Science and Engineering concentration provides an extensive background in the pulp and paper manufacturing processes and elective credit hours for studies in chemistry, marketing, economics, management or other areas of interest to the student. Greater depth in general chemical engineering principles can be obtained from the Chemical Engineering Concentration. Students who have completed the Chemical Engineering Concentration in Paper Science and Engineering can, in cooperation with the College of Engineering and with an additional semester of study, earn a Bachelor of Science in Chemical Engineering as a second degree.

Program Educational Objectives

Within a few years after graduation, alumni of the Paper Science & Engineering Program at NC State University will be:

- Effective engineers and leaders in the paper, chemical process, and related industries.
- Professionals who act in a safe and ethical manner.
- Learners who acquire, analyze, and apply new knowledge effectively.

Summer Internship

All Paper Science and Engineering majors are required to work one summer in a pulp or paper manufacturing facility. One hour of academic credit is granted after completion of 12 weeks of this work and presentation of an engineering report of professional quality. In addition, students are urged to work in manufacturing facilities the other two summers, as the work provides valuable practical experience. Departmental advisers assist students in locating summer jobs, which are found throughout the US and abroad.

Many Paper Science & Engineering students work at least one co-op rotation, in which they leave school for one semester and work in the industry. The resulting experience adds significantly to a student's desirability upon graduation.

Accredited Program

The Paper Science and Engineering program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org.

Regional Program

The Paper Science and Engineering curriculum is a regional program approved by the Southern Regional Education Board as the undergraduate program to serve the Southeast in this field.

Scholarships

Approximately 125 undergraduate academic scholarships worth approximately $380,000 are granted annually to new and continuing students by companies comprising the Pulp and Paper Advisory Board, and by alumni and supporters of the program.

Contact

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Plan Requirements

First Year		Hours
E 101	Introduction to Engineering & Problem Solving [1]	1
E 115	Introduction to Computing Environments	1
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory [2]	4
or		
CH 103 & CH 104	General Chemistry I for Students in Chemical Sciences and General Chemistry Laboratory I for Students in Chemical Sciences	
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory [1]	4
or		
CH 203 & CH 204	General Chemistry II for Students in Chemical Sciences and General Chemistry Laboratory II for Students in Chemical Sciences	
MA 141	Calculus I [2]	4
MA 241	Calculus II [2]	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory [2]	4
PSE 201	Pulping and Papermaking Technology [1]	3
Acad Writing Research (p. 2) [1]		4
Economics Elective (p. 2)		3
	Hours	**32**
Second Year		
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab [1]	4
or		
CH 225 & CH 226	Organic Chemistry I for Students in Chemical Sciences and Organic Chemistry Laboratory I for Students in Chemical Sciences	
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab	4

or		
CH 227 & CH 228	Organic Chemistry II for Students in Chemical Sciences and Organic Chemistry Laboratory II for Students in Chemical Sciences	
MA 242	Calculus III	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
CHE 205	Chemical Process Principles	4
PSE 212	Paper Properties [1]	4
PSE 371	Pulping Process Analysis [1]	3
Advised Electives (p. 3)		3
	Hours	**30**
Third Year		
MAE 201	Engineering Thermodynamics I	3
PSE 322	Wet End and Polymer Chemistry	4
PSE 332	Wood and Pulping Chemistry	3
PSE 355	Pulp and Paper Unit Processes I [1]	3
PSE 360	Pulp and Paper Unit Processes II	3
PSE 370	Pulp and Paper Products and Markets	3
PSE 211	Pulp and Paper Internship	1
Engineering Elective (p. 2)		3
	Hours	**23**
Fourth Year		
PSE 415	Paper Industry Strategic Project Analysis	3
PSE 416	Process Design and Analysis	3
PSE 417	Modeling & Simulation of Pulp & Paper Processes	3
PSE 465	Process Engineering	3
PSE 472	Paper Process Analysis	3
PSE 475	Process Control in Pulp and Paper	3
PSE 425	Bioenergy & Biomaterials Engineering	3
Advised Electives (p. 3)		3
	Hours	**24**
	Total Hours	**109**

[1] A grade of C- or better is required.
[2] A grade of C or better is required.

Code	Title	Hours	Counts towards
GEP Courses			
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		6	
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3	
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2	
GEP US Diversity, Equity, and Inclusion (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-usdei/)		3	
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		5	
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)			
Foreign Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/foreign-language-proficiency/) (verify requirement)			
Total Hours		**19**	

Acad Writing Research

Code	Title	Hours	Counts towards
Acad Writing Research			
ENG 101	Academic Writing and Research	4	
FLE 101	Academic Writing and Research	4	
Transfer Sequence			
ENG 202	Disciplinary Perspectives in Writing	3	
ENG 1GEP		3	

Economics Electives

Code	Title	Hours	Counts towards
ARE 201	Introduction to Agricultural & Resource Economics	3	
ARE 201A	Introduction to Agricultural & Resource Economics	3	
EC 201	Principles of Microeconomics	3	
EC 205	Fundamentals of Economics	3	

Engineering Electives

Code	Title	Hours	Counts towards
BAET 411	Agricultural Machinery and Power Units	4	
CE 214	Engineering Mechanics-Statics	3	

CHE 225	Introduction to Chemical Engineering Analysis	3
ECE 331	Principles of Electrical Engineering	3
MAE 206	Engineering Statics	3
MSE 201	Structure and Properties of Engineering Materials	3
TE 200	Introduction to Polymer Science and Engineering	3

Advised Electives

Code	Title	Hours	Counts towards
ACC 200	Introduction to Managerial Accounting	3	
ACC 210	Concepts of Financial Reporting	3	
ACC 220	Introduction to Managerial Accounting	3	
ACC 280	Survey of Financial and Managerial Accounting	3	
ACC 310	Intermediate Financial Accounting I	3	
ACC 311	Intermediate Financial Accounting II	3	
ACC 340	Accounting Information Systems	3	
ACC 411	Business Valuation	3	
ARE 301	Intermediate Microeconomics	3	
ARE 336	Introduction to Resource and Environmental Economics	3	
BAE 425	Industrial Microbiology and Bioprocessing	3	
BAE 525	Industrial Microbiology and Bioprocessing	3	
BCH 451	Principles of Biochemistry	4	
BUS 320	Financial Management	3	
CH 315	Quantitative Analysis	3	
CH 331	Introductory Physical Chemistry	4	
CH 401	Systematic Inorganic Chemistry I	3	
CH 431	Physical Chemistry I	3	
CH 437	Physical Chemistry for Engineers	4	
CHE 225	Introduction to Chemical Engineering Analysis	3	
CHE 311	Transport Processes I	3	
CHE 312	Transport Processes II	3	
CHE 315	Chemical Process Thermodynamics	3	
CHE 316	Thermodynamics of Chemical and Phase Equilibria	3	
EC 301	Intermediate Microeconomics	3	
EC 302	Intermediate Macroeconomics	3	
EC 336	Introduction to Resource and Environmental Economics	3	
ET 310	Environmental Monitoring and Analysis	3	
ISE 311	Engineering Economic Analysis	3	
MA 225	Foundations of Advanced Mathematics	3	
MA 303	Linear Analysis	3	
MA 305	Introductory Linear Algebra and Matrices	3	
MA 325	Introduction to Applied Mathematics	3	
MA 351	Introduction to Discrete Mathematical Models	3	

MA 401	Applied Differential Equations II	3
MA 402	Mathematics of Scientific Computing	3
MA 403	Introduction to Modern Algebra	3
MA 407	Introduction to Modern Algebra for Mathematics Majors	3
MA 408	Foundations of Euclidean Geometry	3
MA 410	Theory of Numbers	3
MA 421	Introduction to Probability	3
MA 425	Mathematical Analysis I	3
MA 426	Mathematical Analysis II	3
MA 430	Mathematical Models in the Physical Sciences	3
MIE 201	Introduction to Business Processes	3
MIE 305	Legal and Regulatory Environment	3
MIE 330	Human Resource Management	3
MIE 335	Organizational Behavior	3
MSE 201	Structure and Properties of Engineering Materials	3
ST 311	Introduction to Statistics	3
ST 370	Probability and Statistics for Engineers	3
ST 371	Introduction to Probability and Distribution Theory	3
ST 431	Introduction to Experimental Design	3
ST 435	Statistical Methods for Quality and Productivity Improvement	3
ST 535	Statistical Methods for Quality and Productivity Improvement	3

Semester Sequence

This is a sample.

First Year		
Fall Semester		**Hours**
CH 101	Chemistry - A Molecular Science [1]	3
CH 102	General Chemistry Laboratory [1]	1
E 101	Introduction to Engineering & Problem Solving	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research	4
MA 141	Calculus I [1]	4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**15**
Spring Semester		
CH 201	Chemistry - A Quantitative Science	3
CH 202	Quantitative Chemistry Laboratory	1
EC 205 or EC 201 or ARE 201	Fundamentals of Economics or Principles of Microeconomics or Introduction to Agricultural & Resource Economics	3
MA 241	Calculus II [1]	4
PY 205	Physics for Engineers and Scientists I [1]	3
PY 206	Physics for Engineers and Scientists I Laboratory [1]	1
PSE 201	Pulping and Papermaking Technology	3
	Hours	**18**
Second Year		
Fall Semester		
CH 221	Organic Chemistry I	3
CH 222	Organic Chemistry I Lab	1
CHE 205	Chemical Process Principles	4
MA 242	Calculus III	4
PSE 212	Paper Properties	4
	Hours	**16**
Spring Semester		
CH 223	Organic Chemistry II	3
CH 224	Organic Chemistry II Lab	1
PY 208	Physics for Engineers and Scientists II	3
PY 209	Physics for Engineers and Scientists II Laboratory	1
PSE 371	Pulping Process Analysis	3
Advised Elective (p. 3) [1]		3

GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**15**
Third Year		
Fall Semester		
MAE 201	Engineering Thermodynamics I	3
Engineering Elective (p. 2)		3
PSE 211	Pulp and Paper Internship	1
PSE 322	Wet End and Polymer Chemistry	4
PSE 355	Pulp and Paper Unit Processes I [2]	3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**17**
Spring Semester		
PSE 332	Wood and Pulping Chemistry	3
PSE 360	Pulp and Paper Unit Processes II	3
PSE 370	Pulp and Paper Products and Markets	3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
Fourth Year		
Fall Semester		
PSE 415	Paper Industry Strategic Project Analysis	3
PSE 417	Modeling & Simulation of Pulp & Paper Processes	3
PSE 425	Bioenergy & Biomaterials Engineering	3
PSE 475	Process Control in Pulp and Paper	3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
	Hours	**15**
Spring Semester		
PSE 416	Process Design and Analysis	3
PSE 465	Process Engineering	3
PSE 472	Paper Process Analysis	3
Advised Elective (p. 3) [1]		3
GEP Requirement (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		2-3
	Hours	**17**
	Total Hours	**128**

[1] A grade of C- or better is required.

Career Opportunities

Graduates of this curriculum find opportunities for challenging careers as process engineers, product development engineers, process control engineers, chemists, technical service engineers, quality control supervisors, and production supervisors. Design and construction engineering companies employ graduates as project engineers, and pulp and paper machinery/chemical companies use their education and skills for technical service and sales positions. Opportunities for managerial and executive positions are available to graduates as they gain experience.

The broad and intensive nature of this curriculum makes graduates attractive not only to the pulp and paper industry, but also to a variety of other major chemical process and bio-energy industries. This appeal is especially true for the dual degree in Paper Science & Engineering and Chemical Engineering.