

# Paper Science and Engineering (BS): Dual Major

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

**Dr. M. V. Byrd**  
Director of Undergraduate Programs  
919.515.5790  
[med\\_byrd@ncsu.edu](mailto:med_byrd@ncsu.edu)

## Plan Requirements

First Year		Hours
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory <sup>1</sup>	4
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory	4
E 101	Introduction to Engineering & Problem Solving	1
E 115	Introduction to Computing Environments	1
Acad Writing Research (p. 2) <sup>2</sup>		4
MA 141	Calculus I <sup>1</sup>	4
MA 241	Calculus II <sup>1</sup>	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup>	4
PSE 201	Pulping and Papermaking Technology <sup>1</sup>	3
Economics Elective (p. 2)		3
<b>Hours</b>		<b>32</b>

Second Year		Hours
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab	4
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab	4
CHE 205	Chemical Process Principles <sup>2</sup>	4
CHE 225	Introduction to Chemical Engineering Analysis <sup>2</sup>	3
MA 242	Calculus III <sup>2</sup>	4
MA 341	Applied Differential Equations I <sup>2</sup>	3
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
PSE 212	Paper Properties <sup>2</sup>	4
PSE 371	Pulping Process Analysis <sup>2</sup>	3
<b>Hours</b>		<b>33</b>

Third Year		Hours
CHE 315	Chemical Process Thermodynamics <sup>1</sup>	3
CHE 311	Transport Processes I <sup>2</sup>	3

CHE 312	Transport Processes II	3
CHE 316	Thermodynamics of Chemical and Phase Equilibria <sup>2</sup>	3
Chemistry Elective (p. 2)		4
PSE 211	Pulp and Paper Internship	1
PSE 322	Wet End and Polymer Chemistry	4
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
<b>Hours</b>		<b>30</b>
<b>Fourth Year</b>		
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 425	Bioenergy & Biomaterials Engineering	3
PSE 465	Process Engineering	3
PSE 472	Paper Process Analysis	3
PSE 475	Process Control in Pulp and Paper	3
<b>Hours</b>		<b>21</b>
<b>Fifth Year</b>		
CHE 330	Chemical Engineering Lab I	4
CHE 446	Design and Analysis of Chemical Reactors	3
ECE 331 or MSE 201	Principles of Electrical Engineering or Structure and Properties of Engineering Materials	3
<b>Hours</b>		<b>10</b>
<b>Total Hours</b>		<b>126</b>

<sup>1</sup> A grade of C or better is required.

<sup>2</sup> A grade of C- or better is required.

Code	Title	Hours
<b>GEP Courses</b>		
GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )		6
GEP Social Sciences ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/</a> )		3
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		2
GEP Elective ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
GEP Interdisciplinary Perspectives ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/</a> )		5
GEP Global Knowledge ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/</a> ) (verify requirement)		
GEP Foundations of American Democracy ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/</a> ) (verify requirement)		

World Language Proficiency (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/>) (verify requirement)

**Total Hours** **19**

## Acad Writing Research

Code	Title	Hours
<b>Acad Writing Research</b>		
ENG 101	Academic Writing and Research	4
FLE 101	Academic Writing and Research	4
<b>Transfer Sequence</b>		
ENG 1GEP		3
ENG 202	Disciplinary Perspectives in Writing	3

## Economics Electives

Code	Title	Hours
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

## Chemistry Electives

Code	Title	Hours
BCH 351	General Biochemistry	3
BCH 451	Principles of Biochemistry	4
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
CH 315	Quantitative Analysis	3
CH 316	Quantitative Analysis Laboratory	1
CH 331	Introductory Physical Chemistry	4
CH 335	Principles of Green Chemistry	4
CH 437	Physical Chemistry for Engineers	4
FS 402	Chemistry of Food and Bioprocessed Materials	4
FS 403	Analytical Techniques in Food & Bioprocessing Science	4
FS 502	Chemistry of Food and Bioprocessed Materials	4
PCC 461	Chemistry of Polymeric Materials	3
PCC 464	Chemistry of Polymeric Materials Laboratory	1
PSE 335	Principles of Green Chemistry	4

## Semester Sequence

This is a sample.

<b>First Year</b>		
<b>Fall Semester</b>		<b>Hours</b>
CH 101	Chemistry - A Molecular Science <sup>1</sup>	3
CH 102	General Chemistry Laboratory <sup>1</sup>	1
E 101	Introduction to Engineering & Problem Solving <sup>2</sup>	1
E 115	Introduction to Computing Environments	1
ENG 101	Academic Writing and Research <sup>2</sup>	4
MA 141	Calculus I <sup>1</sup>	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 <sup>2</sup> 3

CH 202 Quantitative Chemistry Laboratory 1

Select one of the following: 3

EC 205 Fundamentals of Economics

EC 201 Principles of Microeconomics

ARE 201 Introduction to Agricultural & Resource Economics

MA 241 Calculus II <sup>1</sup> 4

PY 205 & PY 206 Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup> 4

PSE 201 Pulping and Papermaking Technology <sup>2</sup> 3

**Hours 18**

### Second Year

#### Fall Semester

CH 221 Organic Chemistry I <sup>2</sup> 3

CH 222 Organic Chemistry I Lab 1

CHE 205 Chemical Process Principles <sup>2</sup> 4

MA 242 Calculus III <sup>2</sup> 4

PSE 212 Paper Properties <sup>2</sup> 4

GEP Health and Exercise Studies (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/>) 1

**Hours 17**

#### Spring Semester

CH 223 Organic Chemistry II 3

CH 224 Organic Chemistry II Lab 1

CHE 225 Introduction to Chemical Engineering Analysis <sup>2</sup> 3

MA 341 Applied Differential Equations I <sup>2</sup> 3

PY 208 & PY 209 Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory 4

PSE 371 Pulping Process Analysis <sup>2</sup> 3

**Hours 17**

### Third Year

#### Fall Semester

Chemistry Elective (p. 2) 4

CHE 311 Transport Processes I <sup>2</sup> 3

CHE 315 Chemical Process Thermodynamics <sup>2</sup> 3

PSE 211 Pulp and Paper Internship 1

PSE 322 Wet End and Polymer Chemistry 4

GEP Requirement (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/>) 3

**Hours 18**

#### Spring Semester

CHE 312 Transport Processes II 3

CHE 316 Thermodynamics of Chemical and Phase Equilibria <sup>2</sup> 3

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

**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

GEP Requirement (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/>) 3

**Hours 18**

#### Spring Semester

PSE 416 Process Design and Analysis 3

PSE 465 Process Engineering 3

PSE 472 Paper Process Analysis 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 14**

### Fifth Year

#### Fall Semester

CHE 330 Chemical Engineering Lab I 4

CHE 446 Design and Analysis of Chemical Reactors 3

GEP Requirement (<http://catalog.ncsu.edu/undergraduate/gep-category-requirements/>) 3

ECE 331 or MSE 201 Principles of Electrical Engineering or Structure and Properties of Engineering Materials 3

**Hours 13**

**Total Hours 145**

<sup>1</sup> Grade of C (2.0) or higher required.

<sup>2</sup> Minimum grade of C- 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.

## Career Titles

- Chemist
- Conservation Scientist
- Engineer
- Environmental Scientist
- Forest and Conservation Technician
- Forester
- Machinery Sales
- Process Control Engineer
- Product Development Engineer
- Production Supervisor
- Quality Control Supervisor
- Technical Service Engineer

## Learn More About Careers

NCcareers.org (<https://nccareers.org/>)

Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (<https://www.bls.gov/ooh/>)

Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics.

You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (<https://www.careeronestop.org/>)

View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation.

Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (<https://careers.dasa.ncsu.edu/explore-careers/career-assessments/>) (NC State student email address required)

This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (<https://careers.dasa.ncsu.edu/about/hours-appointments/>) to discuss the results.

Focus 2 Apply Assessment (<https://www.focus2career.com/Portal/Register.cfm?SID=1929>) (Available to prospective students)

A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.

National Society of Professional Engineers (<http://www.nspe.org/>)