Paper Science Engineering (PSE)

PSE 201 Pulping and Papermaking Technology (3 credit hours)
Survey of the pulping and papermaking processes. Covers characteristics of wood and different types of fiber, key equipment and process variables for pulping, bleaching and chemical recovery processes, with emphasis on the kraft process. Papermaking variables and equipment, particularly on a Fourdrinier machine, secondary fiber processing, and aspects of printing and coverting discussed.

Typically offered in Spring only

PSE 211 Pulp and Paper Internship (1 credit hours)
Experience in the pulp and paper industry. Problem solving in an industrial setting to gain insight of pulp and paper technology. Written report required. Engineering ethics discussed in light of the work experience.

Prerequisite: PSE 201
Typically offered in Fall only

PSE 212 Paper Properties (4 credit hours)
Measurement and characterization of the structural, mechanical, and optical properties of paper and board. Effect of raw materials and manufacturing processes on structure and properties. Basic concepts of paper physics.

Prerequisite: PSE 201
Typically offered in Fall only

PSE 220 From Papyrus to Plasma Screens: Paper and Society (2 credit hours)
The impact of paper and paper products on society, examined from the broad interdisciplinary perspectives of technology/engineering and sociology/communication. How the written word and printing affected human development and history. How paper products affect people with regard to communication, education, commerce, and comfort/hygiene. The history and development of paper making and the paper industry. Important properties of paper. Basic types of paper products, how they are manufactured, and their impacts The environmental impacts of paper and the paper industry. Current issues involving the paper industry.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PSE 293 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Summer only

PSE 294 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Summer only

PSE 295 Special Topics in Paper Science & Engineering (1-3 credit hours)
Special Topics in Paper Science & Engineering at the 200 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

PSE 322 Wet End and Polymer Chemistry (4 credit hours)
Prepares students to solve problems related to chemical usage on paper machines. Subjects include water chemistry, paper machine operations, fibers, fillers, alum, sizing agents, polyelectrolytes, colloidal interactions, strength agents, dyes, strategies to optimize retention, dewatering strategies, strategies to achieve more uniform paper, strategies to improve production rates, recycling acqueous coatings, and wet-end chemical process control.

Prerequisite: PSE 212 and (CH 221 or CH 225) and (CH 222 or CH 226)
Typically offered in Fall only

PSE 332 Wood and Pulping Chemistry (3 credit hours)
Introduction to carbohydrate chemistry focusing on the structure and reactivity of wood polysaccharides, hemicelluloses and cellulose and on the chemical structure of lignins and wood extractives. Special emphasis on the chemical reaction of wood components occurring in pulping and bleaching processes.

Prerequisite: CH 221/225 and CH 222/226 and CH 223/227 and CH 224/228
Typically offered in Spring only

PSE 335/CH 335 Principles of Green Chemistry (4 credit hours)
Introduction to the topic of green chemistry as an emerging field; Identification of hazards and classes; overview of sources; alternative solvents and reagents; sustainability of chemical reactions; alternative chemical reactions and pathways; alternative feedstocks; enzymatic catalysis; ionic liquids; re-engineering of chemical processes; chemical synthesis.

Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/22 (or equivalent)
Typically offered in Fall only

PSE 355 Pulp and Paper Unit Processes I (3 credit hours)
Selected topics in chemical engineering as applied in the pulp and paper industry. Emphasis on computational practice.

Prerequisite: CHE 205
Typically offered in Fall only

PSE 360 Pulp and Paper Unit Processes II (3 credit hours)
Application of chemical engineering principles to the analysis of pulp and paper unit processes. Emphasis on practical problems in fluid dynamics, heat transfer, mass transfer and thermodynamics. Problem solution techniques include hand calculationand computer simulation tools.

Prerequisite: PSE 201, PSE 355 or CHE 311
Typically offered in Spring only

PSE 370 Pulp and Paper Products and Markets (3 credit hours)
Major product sectors for pulp and paper. Market outlook and analysis. Critical fiber, pulp, finished product requirements and properties. Special emphasis on packaging grades and emerging markets. Technology intelligence and techno-economic tools to identify and address challenges related to selected pulp and paper products. Laboratory session used for research and development of selected products.

Prerequisites: PSE 201 with a C- or better and PSE 212 with a C- or better
Typically offered in Spring only

PSE 371 Pulping Process Analysis (3 credit hours)
Preparation and evaluation of different types of wood pulp. A new wood raw material is selected each year with the purpose of studying and critically evaluating the principal pulping and bleaching variables.

Prerequisite: PSE 201
Typically offered in Spring only

PSE 415 Paper Industry Strategic Project Analysis (3 credit hours)
Design problems in process and project engineering are analyzed from strategic, economic, and business perspectives. Typical pulp and paper processes are computer modeled and analyzed with regard to feasibility and profitability. Specific capital projects are assessed for capital requirements, total installed cost, operating costs, payback, and cash flow. Traditional business concepts are presented, including: financial analysis; capital allocation; marketing and pricing theory; manufacturing work systems; management systems; leadership; what "good" looks like. Senior Standing.

Typically offered in Fall only

PSE 416 Process Design and Analysis (3 credit hours)
Design, management and analysis of technical projects. Emphasis on concepts and techniques used in economic analysis of projects. Use of computer simulation for process design and cost analyses. Team projects to analyze cost and operating feasibility of proposed major mill modification. Written and oral presentations required throughout the semester.

Prerequisite: PSE 415 and PSE 417
Typically offered in Spring only

PSE 417 Modeling & Simulation of Pulp & Paper Processes (3 credit hours)
Application of modeling and simulation techniques for the analysis of pulping and papermaking processes. Model development and computer simulation using existing models will allow analysis of process interactions and operating/economic feasibility of process modifications of complex manufacturing systems.

Prerequisite: PSE 360
Typically offered in Fall only

PSE 425 Bioenergy & Biomaterials Engineering (3 credit hours)
This course acquaints students with the basic science, terminology, technology, economic concepts, and engineering concepts associated with the conversion of biomass into energy and materials. Topics include: biomass types and properties; biochemical platforms; thermochemical platforms; unit operations; the biorefinery; biocomposites. Some design content is included. Targeted to engineering students with a suitable background (PSE, CHE, BAE).

Prerequisite: For PSE Majors: (MAE 201 or CHE 316) and PSE 360; For CHE Majors: CHE 312 and CHE 316; For BAE Majors: MAE 201 and BAE 402
Typically offered in Fall only

PSE 465 Process Engineering (3 credit hours)
Advanced use of process engineering tools in process design, improvement and operation. Particular emphasis is placed on pulp and paper industry. Topics include basic statistics, Lean Six Sigma/DMAIC methodology, statistical software, measurement system analysis, process mapping/value stream mapping, statistical process and quality control, control charts, process capability analysis, hypothesis testing, design of experiments, Excel modeling, and big data analysis. An independent project is required, which can lead to Lean Six Sigma Yellow Belt trained status.

Prerequisite: Senior standing in PSE or SMT
Typically offered in Spring only

PSE 472 Paper Process Analysis (3 credit hours)
Product analysis, materials selection, process planning, manufacture of various types of paper using pilot plant equipment, finished product testing and comparison with standard products. Machine unit operations, materials flow balances, energy balances performed on operations. Team assignments with written and oral presentation of results.

Prerequisite: PSE 212, PSE 322, PSE 371
Typically offered in Spring only

PSE 475 Process Control in Pulp and Paper (3 credit hours)
Overview of the various aspects of control including process modeling, design of control loops and stability analysis in pulp and paper. Emphasis on distributed digital control (DDC), including hands-on programming and control loop development on aDDC computer.

Prerequisite: Senior standing in PSE or SMT
Typically offered in Fall only

PSE 476/FB 576/PSE 576/FB 476 Environmental Life Cycle Analysis (3 credit hours)
Overview of the various aspects of conducting and interpreting an environmental life cycle analysis on a product or service. Students will learn how to construct a life cycle analysis goal and scope, inventory, assessment and interpretation. Skills in the critique and communication of a life cycle analysis will be developed. Includes an overview of the following life cycle stages: raw materials, energy, transportation, production, use, and end of life. Emphasis on systems thinking. Targeted for students in any science or engineering program. Credit not allowed for both PSE 476 and WPS 576.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

PSE 493 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PSE 494 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Summer only

PSE 576/FB 476/PSE 476/FB 576 Environmental Life Cycle Analysis (3 credit hours)
Overview of the various aspects of conducting and interpreting an environmental life cycle analysis on a product or service. Students will learn how to construct a life cycle analysis goal and scope, inventory, assessment and interpretation. Skills in the critique and communication of a life cycle analysis will be developed. Includes an overview of the following life cycle stages: raw materials, energy, transportation, production, use, and end of life. Emphasis on systems thinking. Targeted for students in any science or engineering program. Credit not allowed for both PSE 476 and WPS 576.

GEP Interdisciplinary Perspectives
Typically offered in Fall only