PHYS 4420* Electromagnetics II 3(3) Continuation of PHYS 4410. Study of foundations of electromagnetic theory. Topics include magnetic properties of matter, microscopic theory of magnetization, electromagnetic induction, magnetic energy, AC circuits, Maxwell's equations, and propagation of electromagnetic waves. Other topics may include waves in bounded media, antennas, electrodynamics, special theory of relativity, and plasma physics. Includes Honors sections. Preq: PHYS 4410.

PHYS 4450* Solid State Physics I 3(3) Topics include an overview of crystal structures, chemical and atomic bonding, and periodicity in relation to solid materials. Covers electronic, thermal, and magnetic properties of materials, electrical conduction in metals and semiconductors. Overview of the role of electrons and phonons and their interactions is presented. Includes Honors sections. Preq: PHYS 2210.

PHYS 4460* Solid State Physics II 3(3) Continuation of PHYS 4450, including selected topics in solid-state physics such as optical properties, superconductivity, non-crystalline solids, dielectrics, ferroelectrics, and nanomaterials. Plasmons, polarons, and excitons are discussed. Brief introduction into methods of solid-state synthesis and characterization tools is presented. Includes Honors sections. Preq: PHYS 4450.

PHYS 4520* Nuclear and Particle Physics 3(3) Study of our present knowledge concerning subatomic matter. Experimental results are stressed. Topics include particle spectra, detection techniques, Regge pole analysis, quark models, proton structure, nuclear structure, scattering and reactions. Includes Honors sections.

PHYS 4550* Quantum Physics I 3(3) Discussion of solution of the Schroedinger equation for free particles, the hydrogen atom, and the harmonic oscillator. Includes Honors sections. Preq: PHYS 3220.

PHYS 4560* Quantum Physics II 3(3) Continuation of PHYS 4550. Application of principles of quantum mechanics as developed in PHYS 4550 to atomic, molecular, solid state, and nuclear systems. Includes Honors sections. Preq: PHYS 4550.

PHYS 4650* Thermodynamics and Statistical Mechanics 3(3) Study of temperature development of the laws of thermodynamics and their application to thermodynamic systems. Introduction to low temperature physics is given. Includes Honors sections. Preq: PHYS 3210.

PHYS 4750* Selected Topics 1-3(1-3) Comprehensive study of a topic of current interest in the field of physics. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

PHYS 4810 Physics of Surfaces 3(3) Introduction for advanced undergraduates to the physics and chemical physics of solid surfaces and to the interaction of atoms and molecules with those surfaces. Preq: PHYS 3120 and PHYS 3220 and PHYS 3250 and PHYS 3260 and PHYS 4410.

PHYS 4820 Surface Experiments 3(2) Introduction for advanced undergraduates to experimental methods of surface physics. Includes on-hands experience in advanced laboratory. Preq: PHYS 3120 and PHYS 3220 and PHYS 3250 and PHYS 3260 and PHYS 4410. Coreq: PHYS 4821.

PHYS 4821 Surface Experiments Laboratory 0(3) Non-credit laboratory to accompany PHYS 4820. Coreq: PHYS 4820.

PHYS 4990 Creative Inquiry–Physics and Astronomy 1-4(1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. To be taken Pass/No Pass only. May be repeated for a maximum of eight credits. Preq: Consent of faculty member/mentor.

PACKAGING SCIENCE

Professors: K.D. Cooksey, *Endowed Chair,* A.L. Pometto III, E.J. Rhodehamel, *Chair*, W.S. Whiteside*; Associate Professors:* D.O. Darby, R.M. Kimmel; *Assistant Professors:* G.S. Batt, R.A. Hurley; *Senior Lecturers:* H.P. Batt, R.T. Moore; *Lecturers:* E.M. Snyder, T.T. Stuettgen; *Adjunct Professors:* A.L. Brody, R.C. Cooksey, T.W. Downes, H.J. Park; *Adjunct Associate Professors:* L.L. Bix, M.P. Daum, R.L. Kaas; *Adjunct Assistant Professor:* J.M. Gibert

PKSC 1010 Packaging Orientation 1(1) Overview of the various principles and practices in packaging science, historical development, packaging as a career.

PKSC 1020 Introduction to Packaging Science 2(2) Considers functions of a package; materials, processes, and technology used in package development; and the relationship of packaging to the corporation, consumer, and society as a whole.

PKSC 2010 Packaging Perishable Products 3(3) Covers fundamental characteristics and applications of various materials and systems used to package perishable products such as foods and pharmaceuticals. Discusses packaging issues regarding food, pharmaceutical, and medical packaging. Includes product/package interactions and packaging requirements to address basic theory in food and pharmaceutical protection. Preq or concurrent enrollment: CH 2010 and PKSC 1020 and PKSC 2020.

PKSC 2020 Packaging Materials and Manufacturing 4(3) Detailed study of packaging materials including glass, metal, metal foils and sheets, wood, paper, paperboard, plastics, composites, adhesives, coatings, cushioning media; their functional properties in packaging application; laminating and combining of different packaging materials. Preq: PKSC 1020. Coreq: PKSC 2021.

PKSC 2021 Packaging Materials and Manufacturing Laboratory 0(3) Non-credit laboratory to accompany PKSC 2020. Coreq: PKSC 2020.

PKSC 2030 Packaging Research Fundamentals 2(2) Principles, methods, and resources for organizing, researching, and reporting technical work in packaging science. Preq: PKSC 1020 and PKSC 1030 and ENGL 1030 and Packaging Science major.

PKSC 2040 Container Systems (Rigid and Flexible) 3(3) Examination of all the packages and containers used to develop systems to distribute products. Compatibility of product and package, structural design, costs, and merchandising considerations are stressed. Preq: PKSC 1020 and PKSC 2020. Coreq: PKSC 2060.

PKSC 2060 Container Systems Laboratory 1(3) Laboratory practice in sample making, designing and constructing various containers. Preq: PKSC 1020. Coreq: PKSC 2040.

PKSC 2200 Product/Package Design and Prototyping 4(2) Overview of structural and graphic development tools for product and packaging design. Focus on digital creation, photo rendering, wide-format plotting/proofing, rapid prototyping, visualization and real-time 2d/3d design. Course utilizes online lectures and hands-on laboratory experience at The Sonoco Institute. Preq: PKSC 1020. Coreq: PKSC 2201.

PKSC 2201 Product/Package Design and Prototyping Laboratory 0(6) Non-credit laboratory to accompany PKSC 2200. Coreq: PKSC 2200.

PKSC 3200 Packaging Design Theory 3(2) Study of human factors psychology as it relates to product and package development. Lecture topics center on advanced color theory, space, shape, texture, pattern, typography, branding, marketing, consumer studies, ergonomics, sustainability and applied packaging. Laboratory focuses on developing retail packaging through applying course theory, group development and peer critique. Preq: PKSC 1020 and PKSC 2200. Coreq: PKSC 3201.

PKSC 3201 Packaging Design Theory Laboratory 0(3) Non-credit laboratory to accompany PKSC 3200. Coreq: PKSC 3200.

PKSC 3680 Packaging and Society 3(3) Study of the role of packaging in society as it specifically relates to the responsibilities of the packaging scientist in protecting people and the environment. Includes study of packaging and environmental regulations and guidelines currently in place to achieve these goals. Ability to make informed decisions and ethical judgments is an encompassing goal. Includes Honors sections.

PKSC 4010* Packaging Machinery 3(3) Systematic study of types of machinery used to form, fill, seal, and handle various packaging, products, and packaging materials. Emphasizes basic mechanical, electrical, pneumatic, and hydraulic components of packaging machinery along with packaging machinery terminology. Discusses methods for machine line optimization and layout. Preq: Packaging Science major or minor or Food Science and Human Nutrition major or Food Science minor; and FDSC 2140 or PKSC 2040.

PKSC 4030 Packaging Career Preparation 1(1) Preparation for a successful career in Packaging Science by completing the professional e-portfolio, and finalizing a resume and career e-portfolio. Refines career skills through role playing. Topics include presentations, interviewing, effective collaboration and communication, business and foreign travel etiquette. Preq: Packaging Science major or minor. Coreq: PKSC 4200.

PKSC 4040* Mechanical Properties of Packages and Principles of Protective Packaging 3(3) Study of the mechanical properties of products and packages and standard methods of determining these properties. Focuses on the functional properties of packages related to shock and vibration isolation and compression. Includes Honors sections. Preq: Packaging Science major or minor and junior standing; and MATH 1060 and PKSC 1020 and PKSC 2040; and one of PHYS 1220 or PHYS 2070.

PKSC (FDSC) 4090 Total Quality Management for the Food and Packaging Industries 3(3) Introduction to the principles of modern quality management emphasizing quality standards and issues and the practices necessary for food processing and packaging companies to survive in a customer-driven marketplace. May also be offered as FDSC 4090. Preq: STAT 2300.

PKSC 4160* Application of Polymers in Packaging 4(3) Detailed study of polymer science and engineering as applied to packaging science. Includes polymer morphology, rheology, physical properties, processing methods, and polymerization. Emphasizes relationships among processing, structure, and properties. Preq: Packaging Science major or minor; and PKSC 1020 and PKSC 2040 and PKSC 2060; and one of CH 2010 or CH 2230; and one of PHYS 1220 or PHYS 2070. Coreq: PKSC 4161.

PKSC 4161* Application of Polymers in Packaging Laboratory 0(3) Non-credit laboratory to accompany PKSC 4160. Coreq: PKSC 4160.

PKSC 4200* Package Design and Development 3(2) Study of the principles and methods practiced in designing and developing packages and packaging systems and of methods used to coordinate and analyze package development activities including interfacing with product development, manufacturing, marketing, purchasing, and accounting. Preq: Packaging Science major or minor and second semester senior standing; and PKSC 1020 and PKSC 3200 and PKSC 3680 and PKSC 4400. Preq or concurrent enrollment: PKSC 4010 and PKSC 4040 and PKSC 4160 and PKSC 4300 and PKSC 4540 and PKSC 4640. Coreq: PKSC 4030 and PKSC 4201.

PKSC 4201* Package Design and Development Laboratory 0(3) Non-credit laboratory to accompany PKSC 4200. Coreq: PKSC 4200.

PKSC 4210 Special Problems in Packaging Science 1-4(1-4) Independent research investigations in packaging science related to packaging materials, machinery, design, and applications. Special emphasis is placed on organizing a research proposal, conducting research, and reporting results. May be repeated for a maximum of 15 credits. Preq: Consent of instructor.

PKSC 4220 Selected Topics in Packaging Science 1-3(1-3) Comprehensive study of selected topics in packaging science not covered in detail or contained in other courses. Contemporary developments in each area are stressed. May be repeated for a maximum of 15 credits, but only if different topics are covered. Preq: Consent of instructor.

PKSC 4230* 3D Parametric Design Online 3(3) Provides an overview of the techniques used in designing 3D parametrics solid parts for packaging science applications. The course begins with a basic overview of design software and progresses to cover advanced applications, including simulation, surfacing, tooling, photorendering and sustainability. Additionally, this course prepares students for a professional certification exam. Recommended for students who have experience with design software.

PKSC 4240* Structural Packaging Design Online 3(3) Provides a comprehensive overview of how to design structural packaging for paperboard and corrugated mediums. This course begins with a basic overview and transitions into covering advanced applications. Access to design software (vector-based 2D CAD software, such as Illustrator or ArtiosCAD) is required. Recommended for students with design software experience.

PKSC 4300* Converting for Flexible Packaging 3(1) Study of materials, methods, processes, and equipment used in converting web materials for flexible packaging. Laboratory provides hands-on experience preparing and operating pilot-scale converting equipment. Preq: Packaging Science major or minor; and PKSC 1020 and PKSC 2040. Coreq: 4301.

PKSC 4301* Converting for Flexible Packaging Laboratory 0(6) Non-credit laboratory to accompany PKSC 4300. Coreq: PKSC 4300.

PKSC 4400* Packaging for Distribution 3(3) Packages are exposed to various shipping methods and numerous hazards during distribution. To ensure adequate product protection, packaging professionals need to understand the fundamental principles of distribution packaging design. Topics include ASTM and ISTA packaging test methods, packaging design guidelines for distribution, terminology, transport modes, distribution hazards, and protective packaging materials. Preq: Packaging Science major or minor; and PKSC 1020 and PKSC 4040.

PKSC 4540* Product and Package Evaluation Laboratory 1(3) Laboratory experiments to determine properties of packaging materials and to evaluate the response of packages and products to shock, vibration, and compression. Students operate standard testing equipment and become familiar with industry recognized test methods and standards. Preq: Packaging Science major or minor; and PKSC 1020. Preq or concurrent enrollment: PKSC 4040.

PKSC 4640* Food and Health Care Packaging Systems 4(3) Characteristics, engineering properties, and applications of various materials and systems used in the packaging of foods, pharmaceuticals, and medical devices. Packaging systems for specific food and medical applications are considered. Laboratory and field exercises on food and medical packaging operations and packaging materials are included. Emphasis is on evaluation methods. Includes Honors sections. Preq: Packaging Science major or minor or Food Science and Human Nutrition major or Food Science minor; and one of PKSC 2010 or FDSC 2140; and PKSC 1020 and PKSC 2040. Coreq: PKSC 4641.

PKSC 4641* Food and Health Care Packaging Systems Laboratory 0(3) Non-credit laboratory to accompany PKSC 4640. Coreq: PKSC 4640.

PKSC 4950 Senior Honors Research in Packaging Science 3(1) With professor supervision, students select a well-defined research question, plan the experimental design, perform data collecction and results analysis, and prepare a project summary. Preq: Membership in Calhoun Honors College. Coreq: PKSC 4951.

PKSC 4951 Senior Honors Research in Packaging Science Laboratory 0(6) Non-credit laboratory to accompany PKSC 4950. Coreq: PKSC 4950.

PKSC 4980 Creative Inquiry Laboratory 1-3(3-9) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams based on laboratory experimentation. Projects may be interdisciplinary in nature. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits, but the combined credits earned from PKSC 4980 and 4990 may not exceed eight.

PKSC 4990 Creative Inquiry—Packaging Science 1-3(1-3) Students engage in creative inquiry projects such as surveys or literature research that do not require a laboratory component. Projects may be interdisciplinary in nature. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits, but the combined credits earned from PKSC 4980 and 4990 may not exceed eight.

PLANT PATHOLOGY

Professors: S.N. Jeffers, S.B. Martin, S.W. Scott; *Associate Professors:* P. Agudelo, J. Kerrigan

PLPA 2130 Fungi and Civilization 3(3) Overview of how fungi affect the lives of humans, both currently and historically. Addresses the diversity of fungi and the tremendous roles fungi play on the planet with respect to the biological, social and ethical consequences. The general nature of this course makes it beneficial to all students.

PLPA 3020 Plant Pathology Research 1-3(1-3) Research experience in a plant pathology project for undergraduates who understand basic concepts of research. Students develop research objectives, procedures, and collect data. A written report includes interpretation of results. To be taken Pass/No Pass only. Includes Honors sections. Preq: Consent of instructor.

PLPA 3100 Principles of Plant Pathology 3(2) Introduction to plant diseases caused by biotic agents and abiotic disorders, recognition of symptoms and signs, types of plant pathogens, diagnosis, disease development, economics, disease management, and effects of plant diseases on human welfare and the environment. Preq: BIOL 1110; or BIOL 1040 and BIOL 1060. Coreq: PLPA 3101.

PLPA 3101 Principles of Plant Pathology Laboratory 0(3) Non-credit laboratory to accompany PLPA 3100. Coreq: PLPA 3100.

PLPA (ENT) 4060* Diseases and Insects of Turfgrasses 2(2) Host-parasite relationships, symptomatology, diagnosis, economics, and control of infectious diseases of turfgrasses and life histories, diagnosis, and control of important insect pests of turfgrasses. May also be offered as ENT 4060. Preq: ENT 3010 and PLPA 3100.

PLPA (ENT) 4080* Diseases and Insects of Turfgrasses Laboratory 1(3) Laboratory to complement PLPA 4060 or ENT 4060 to learn symptomatology, diagnosis, and control of infectious diseases of turfgrasses and diagnosis of damage caused by important insect pests of turfgrasses. May also be offered as ENT 4080. Preq: PLPA 4060 or ENT 4060.