DOWNLOAD PDF BIOLOGICAL AND BIOENVIRONMENTAL HEAT AND MASS TRANSFER (FOOD SCIENCE AND TECHNOLOGY)

Chapter 1 : Biosystems Engineering - BSEN < Auburn University

Providing a foundation in heat and mass transport, this book covers engineering principles of heat and mass transfer. The author discusses biological content, context, and parameter regimes and supplies practical applications for biological and biomedical engineering, industrial food processing, environmental control, and waste management.

Introduction to experimental design methodology, basic engineering design and problem solving methodology for Biological Engineering. Visualization skills, computer-aided 3-D solid modeling of parts, 3-D assembly of solid part geometries, computation of mass properties, 2-D engineering drawings, engineering design process, safety, tools and fabrication processes and design, and hands-on shop fabrication of semester project. Basic principles of heat and mass transfer with special applications to biological and environmental systems. Introduction to steady state and transient heat conduction. Convection, radiation, diffusion, simultaneous heat and mass transfer, and generation and depletion of heat and mass in biological systems. Basic engineering analysis, synthesis, and design concepts applied to power sources, mobile equipment, and machinery applications for agricultural, forestry, and natural resource systems. Engineering analysis applied to natural resource systems. Design principles and practices in rainfall-runoff relationships, soil erosion and its prediction and control, hydraulic structures, and open channel hydraulics. Theory and application of process operations in biological, food and agricultural systems. Heat transfer, fluid flow, thermal processing, evaporation, psychrometrics, refrigeration, drying freezing. Engineering aspects of spatial technologies applied to agricultural and forest production. Data collection in the field using GPS and use of field data in site specific applications. Fluid properties, Non-Newtonian fluids and biological systems, Fluid statics, Energy equation, mass and momentum balance, pipe flow for Newtonian and Non-Newtonian fluids, dimensional analysis, compressible flows. Irrigation system design for turf-based systems including residential lawns, commercial properties, athletic fields, and golf courses. Irrigation scheduling and water demand are presented to provide management capabilities. Understanding of fundamentals of electrical circuits, sensing and sensors, simple digital electronics, analog measurement circuits, introductory digital signal processing, computer data acquisition. Theory and design of irrigation systems for the application of water and wastewater including surveying techniques for system design. Systems include solid-set, traveler, center-pivot, and trickle. The course is designed to enable students to develop fundamental understanding of the properties of bulk biological solids and how these properties influence the behavior and processability of bulk solids. Principles of energy transfer by means of fluid power. Design of hydraulic control systems using prime movers, valves, actuators, and accessories. This course focuses on issues related to the professional practice of biological engineering including preparing students for transition to careers as professional engineers. Capstone design course in biosystems engineering emphasizing teamwork, communication, safety engineering, and economic analysis to complete an engineering design project. Faculty supervision of individual student investigations of specialized problems in biosystems engineering. May be repeated with change in problem. Course may be repeated with change in topics. Course may be repeated for a maximum of 3 credit hours. Individual or small group study of a specialized area in biosystems engineering. Course may be repeated for a maximum of 12 credit hours. Directed research in the area of specialty within the department. Course may be repeated for a maximum of 4 credit hours. Collecting, managing, and analyzing spatial data for agricultural and forest systems. Introduction to animal waste management problems of confined production systems, and characterization of animal waste types. Design of biological treatment and processing systems. Modeling of biosystems, methods to deal with complexity, and validation tools. Application and use of renewable energy in biological, food, forest and agricultural systems including bioenergy, solar energy, wind power and geothermal. Or with the consent of the instructor. Introduction of basic principles of bioprocess engineering and metabolic engineering, to prepare engineers and scientists for biotechnology and bioeconomy industries. Introduces the concept of life cycle assessment LCA in in the context of biological engineering. Examples will

include LCA applications to engineered biological systems and other engineering processes and products. An introduction to the basic design, operation, and maintenance of modern commercial animal housing systems. Emphasis will be placed on poultry and swine systems with elements of dairy and beef when applicable. Ecological engineering non-point source transport of nutrients, sediment, pesticides, pathogens, and chemicals from agricultural, forestry, and urban activities. Modeling of non-point source pollution at watershed scale using Soil and Water Assessment Tool model including underlying processes that control movement of pollutants. This course introduces the various processes and engineering principles in converting biomass into biofuels and chemicals. The focus will be on thermochemical and biochemical conversion platforms. Engineering concepts and unit operations used in processing food products. Development of student skills in computer-aided site design and restoration by using rural and urban best management practices to reduce environmental impacts. Introduction to the animal waste management problems of confined production systems and characterization of animal waste types. Application and se of renewable energy in biological, food forest and agricultural systems including biomass and bioenergy, solar energy, wind power and geothermal. An introduction of basic principles of bioprocess engineering and metabolic engineering, to prepare engineers and scientists for biotechnology and bioeconomy industries. Departmental approval This course introduces the concept of life cycle assessment LCA in in the context of biological engineering. The course introduces students to ecological engineering non-point source transport of nutrients, sediment, pesticides, pathogens, and chemicals from agricultural, forestry, and urban activities. The course covers modeling of non-point source pollution at the watershed scale using Soil and Water Assessment Tool model including underlying processes that control movement of pollutants. The course is designed to develop student skills in computer-aided site design and restoration by using rural and urban best management practices to reduce environmental impacts. Theory and application of remote sensing to quantifying soil and vegetation characteristics, with emphasis on agriculture but also relevant to natural biosystems. The course will overview new concepts and technologies for equipment usage and technologies applied for site-specific crop management. Analyses and measurements of soil reactions as affected by physical properties of soil when subjected to forces imposed by tillage implements and traction devices. Students will gain an understanding of the fundamentals of sensing and sensors, simple digital electronics and measurement circuits, introductory digital signal processing, and computer data acquisition. They will be required to build and test instrumentation to collect data on biological systems that might include fluid flow, pressure, force, or other transducers. Solving problems in biosystems engineering and related fields by modeling data with probability distributions, spatial statistics, autoregressive models, Monte-Carlo simulation, and reliability methods. Exploration of geographic information systems GIS and its applications in precision agriculture. Topics include file structure and formatting, interfacing with precision agriculture equipment, georeferencing maps, merging and clipping farm data, data field calculations, designing management zones, variable rate prescriptions, and basic data analysis. Understanding of the basic principles, applications, modeling, energetic and economic analysis of renewable energy resources namely solar, biomass, wind, hydropower and geothermal. Design of renewable energy systems. The course is an advance analysis of the unit operations used to process and enhance the value of biological materials. Insight of technologies and approaches used in food thermal processing for commercial purposes. Application of fundamentals of heat transfer, thermo-bacteriology, physical and chemical kinetics of food, and plant layout. Non-point source NPS transport of nutrients, sediment, pesticides, and pathogens from agricultural, forestry, and urban activities. Basic concepts of pollutant transport through soils and with overland flow. Evaluation, management, and prevention of non-point pollution of surface and groundwater. Non-point source NPS modeling of nutrients, sediment, pesticides, and pathogens from agricultural, forestry, and urban activities. Design applications of environmental remediation include constructed wetlands, drip irrigation of wastewater effluent, disposal of municipal sludge, and phytoremediation of contaminants in shallow groundwater. Knowledge and understanding of the causes, impacts, and methods of restoring water quality impairments, with emphasis

placed on impounded water bodies and perennial streams. Emphasis on applications in environmental engineering projects such as stream restoration and wetland design. Water measurement and structure sizing. Identification of water quality problems and water quality variable selection. Monitoring design, water quality sampling equipment, and sample collection. This course aims at equipping students with the engineering tools and knowledge needed for advanced courses in land and water engineering. This course provides an overview of stream geomorphology as it relates to natural stream physical processes. This course presents the principles of water movement and fate in shallow water table systems and application of the drainage water management model DRAINMOD to a wide variety of problems. This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. This course is designed to introduce students to several innovative stormwater practices including stormwater wetlands, bioretention, green roofs, permeable pavement, cisterns, and others. Critical thinking about the use of various stream restoration structures an providing the tools needed to investigate further into failure analysis and risk assessment. Theory and application of hydraulics in open channels with an emphasis on natural systems natural streams and rivers. Fundamental understanding of hydrology, soils and ecology of natural wetland systems to serve as the basis of designing wetland systems for water treatment and restoring degraded natural wetlands. Faculty supervision of individual student investigations of advanced specialized problems in biosystems engineering at the graduate level. Reviews and discussions of research techniques, current scientific literature, and recent developments in biosystems engineering. Individual or small group studey of an advanced specialized area in biosystems engineering at the graduate level. Course may be repeated with change in topic.