

## Descriptions — Fisheries & Wildlife

of

### Courses

#### 871. Ecology of Fishes

Summer of even-numbered years. 3 credits. Approval of department. Given at the W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Exploration of ecological problems with particular emphasis on growth, food and habitat selection, population biology and niche relations. Field and experimental investigations of fish communities.

#### 872. Fish Communities and Aquatic Ecosystems

Winter of even-numbered years. 3(3-0) Approval of department.

Processes by which fish influence the structure and function of aquatic ecosystems.

#### 873. Ecology and Management of Stream Fish

Winter of odd-numbered years. 3(4-0) F W 376, ZOL 389 or BOT 450; or F W 476 or concurrently.

Flowing water habitat as it affects fish, with influences of climate, vegetation, land use, water withdrawal; damming, channel alteration and fishery management.

#### 874. Advanced Biological Limnology

Fall of odd-numbered years. 3(4-0) F W 477, or approval of department.

Historical and current contributions to concepts of community structure, energy flow and materials cycling in aquatic eco-systems.

#### 875. Chemical Limnology

Winter. 4(3-3) F W 476, F W 477 or approval of department.

Application of analytical chemistry concepts and technologies to fundamental chemical mechanisms in natural and polluted water systems. Special consideration given to selected heterogeneous equilibria.

#### 876. Applied Limnology

Spring. 3(3-0) F W 874 or F W 875 or approval of department.

Aquatic ecology: quantitative relationship between physical, chemical and biological parameters in polluted and unpolluted lakes and streams.

#### 877. Fish Population Dynamics

Winter of odd-numbered years. 3(3-0) Approval of department.

Quantitative analysis of fish populations; rates of change and their underlying causes.

#### 878. Dynamics of Aquatic Contaminants

Spring of even-numbered years. 4(2-4) F W 476, F W 477 or approval of department.

Movement of contaminants through aquatic ecosystems. Chemical and physical processes controlling decomposition and disposition of contaminants. Relationship of chemical form to bioavailability and toxicity. Statistical and deterministic predictive simulation models.

#### 897. Ecosystem Ecology

Fall. 3(3-0) ZOL 389 or BOT 450. Interdepartmental with and administered by the Department of Zoology.

Concepts of ecosystem structure, energy flow, and nutrient cycling in representative terrestrial and aquatic ecosystems.

#### 899. Master's Thesis Research

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

#### 940. Quantitative Wildlife Ecology

Fall of odd-numbered years. 3(3-0) Approval of department.

Fundamentals of population demographics. Rates of increase, dynamic and static life tables, logistic theory, the Leslie matrix model, age specific and time specific parameters. Current hypotheses on mechanisms promoting population stability.

#### 999. Doctoral Dissertation Research

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

## FOOD SCIENCE AND HUMAN NUTRITION

### College of Agriculture and Natural Resources College of Human Ecology

#### Food Science

FSC

#### 101. Food and Society (N)

Fall, Winter, Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods.

Analysis of the scientific, social and environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

#### 205. Food Laws and Regulations

Spring. 3(3-0) Interdepartmental with Human Nutrition and Foods.

Food laws and regulations that govern food processing and food service systems; procedures involved in adopting and enforcing food laws and regulations.

#### 211. Introduction to Food Science

Winter, Spring. 3(3-0) CEM 141B.

Modern food processing, world food problems, and the basic characteristics of processed foods.

#### 256. Meats, Poultry and Fishery Products I

(242.) Fall. 3(2-2) Interdepartmental with the Department of Animal Science.

Principles of evaluation and nutritive value. Identification of grades and cuts of beef, pork, lamb and poultry products.

#### 300. Dairy Products

Spring. 3(2-2) CEM 143 or approval of department.

Chemical and physical properties of milk and milk products. Survey of dairy products and the technologies involved in their manufacture.

#### 310. Food Safety and Microbiology

Fall. 4(3-3) CEM 143 or concurrently or approval of department. Not open to students with credit in FSC 440. Interdepartmental with the Department of Microbiology and Public Health.

Effects of food handling, preparation and service on food safety. Microorganisms in foods, sanitation, food borne disease and food service regulations.

#### 328. Food Plant Sanitation

(FSC 332.) Winter. 3(3-0) FSC 211, MPH 200, CEM 141B.

Sanitary aspects of food processing operations, water quality, equipment design, bactericidal agents, pest control, personnel hygiene, biological hazards, and regulatory agencies. Field trips required.

#### 328L. Laboratory in Food Plant Sanitation

Winter. 1(0-3) FSC 328 or concurrently.

Sanitary aspects of food processing operations water quality, and related hygienic aspects. Field trips required.

#### 329. Unit Operation and Food Processing I

Fall. 4(3-2) PHY 237, MTH 109. Interdepartmental with and administered by Agricultural Engineering Technology.

Engineering concepts related to the unit operations found in the food industry. Fluid mechanics, heat transfer and rate processes including psychrometrics and refrigeration.

#### 330. Food Processing Operations

(FSC 331.) Winter. 3(3-0) PHY 237, FSC 211, or approval of department.

Unit operations for food preservation by low temperature, heat, dehydration, evaporation and separation processes.

#### 330L. Laboratory in Food Processing Operations

Winter. 1(0-2) FSC 330 or concurrently.

Demonstrations, workshops, and pilot-scale processing illustrating selected unit operations in food manufacture.

#### 333. Food Chemistry

Spring. 3(3-0) FSC 211 and CEM 241 or approval of department.

Chemical changes in foods that affect the texture, color, flavor, odor, stability, and nutritive quality during processing and storage.

#### 333L. Laboratory in Food Chemistry

Spring. 1(0-3) FSC 211, CEM 241 and FSC 333 or concurrently.

Chemical changes in food that affect quality and stability.

#### 400. Milk Processing Technology

Fall. 4(3-3) CEM 241 or approval of department.

The fluid milk industry. Composition, quality, sanitation, nutritive value, processing, packaging and distribution of milk and milk products.

#### 401. Industrial Food Fermentations

Fall. 3(3-0) FSC 440 and organic chemistry or approval of department.

Physical, microbiological and chemical procedures in utilizing microbial cultures in controlled fermentations of foods and food constituents.

#### 402. Chemistry and Technology of Lipids

Winter. 3(3-0) One term organic chemistry.

Chemical and physical properties of edible fats and oils. Refining and processing of lipids into margarine, butter, shortening and salad oils. Chemical methods for analysis of lipids.

- 405. Technology of Manufactured Dairy Products**  
 Winter. 4(3-3) FSC 400 or approval of department.  
 Manufacturing technology of fermented dairy foods, frozen dairy desserts, and imitation dairy products.
- 421. Food Plant Management**  
 Spring. 3(3-0) Seniors or approval of department.  
 Business and technical management concepts associated with food plants. Efficiency factors, regulatory obligations, and administrative aspects.
- 430. Thermal Processes for Foods**  
 Winter. 3(2-2) AET 329, FSC 328 or concurrently.  
 Process design concepts with emphasis on heating and cooling of foods in containers. Parameters used to describe thermal resistance of product components. Process time calculations for thermal processes.
- 440. Food Microbiology**  
 Spring. 3(3-0) MPH 200 or MPH 301 or approval of department. Interdepartmental with the Department of Microbiology and Public Health.  
 Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.
- 441. Food Microbiology Laboratory**  
 Spring. 2(0-4) FSC 440 or concurrently or approval of department. Interdepartmental with the Department of Microbiology and Public Health.  
 Laboratory practice with major groups of microorganisms of importance to the food industry. Concurrent enrollment in FSC 440 recommended.
- 445. Meat, Poultry and Fishery Products III**  
 Spring. 4(2-4) FSC 333 or approval of department.  
 Processing, formulation and quality control.
- 455. Food Analysis I**  
 Fall, Spring, Summer. 4(2-4) CEM 162, CEM 241 or approval of department.  
 Modern methods of analysis for fat, protein, moisture and other macroconstituents of food. Application of spectrophotometry in determination of microconstituents; use of dye-binding, complexometric and iodimetric techniques in food analysis.
- 456. Food Analysis II**  
 Winter. 4(2-6) CEM 162 and CEM 241 or approval of department.  
 Use of colorimetry and spectrophotometry, chromatographic methods and other techniques for the analysis of food constituents and additives.
- 457. Quality Control in the Food Industry**  
 Winter of even-numbered years. 3(3-0) STT 201 or approval of department.  
 Organization of and tools used for quality control: control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability.
- 460. Fruit and Vegetable Processing**  
 Fall. 4(3-3) FSC 330 or approval of department.  
 Product composition, harvesting, quality indexes, post-harvest changes, thermal process systems and freezing techniques.
- 470. Cereal Products Technology**  
 Spring. 3(3-0) FSC 330 or approval of department.  
 Classification and composition of food grains, milling processes, quality parameters, baking technology, breakfast cereals, and extrusion technology.
- 480. Special Problems in Food Science**  
 Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits.  
 Advanced undergraduates may select research work in food chemistry, food microbiology, food engineering, food plant management, processing dairy products, meat, poultry and fishery products, fruits and vegetables, cereals or beverages.
- 490. Seminar**  
 Fall. 1(1-0) Approval of department.  
 Preparation and presentation of reports on a specialized aspect of food science.
- 830. Advanced Thermal Processes for Foods**  
 Spring. 4(3-3) FSC 430, or approval of department.  
 Integration of kinetic parameters for food product components and heat and mass transfer relationships into prediction models for food product quality.
- 831. Rheology and Texture of Food**  
 Winter. 3(2-2) Approval of department.  
 Definition, measurement, analysis of and relationship between the rheological and textural parameters which describe food. Relationship between basic rheology and food texture.
- 832. Microbiology of Food Processing**  
 Winter of odd-numbered years. 2(2-0) FSC 440 or approval of department.  
 Relationship of environment to occurrence, growth and survival of microorganisms in foods, control of food spoilage and food poisoning microorganisms in food processing. Role of spores in process selection.
- 834. Flavor Quality Control**  
 Spring of odd-numbered years. 4(3-3) Approval of department.  
 Sensory methods used for food evaluation and panel analyses. Flavor chemistry and analytical methods. Sampling plans, control charts, and acceptance sampling for statistical quality control.
- 835. Carbohydrates in Foods**  
 Fall of odd-numbered years. 3(3-0) FSC 333.  
 The chemistry and food technology of mono-, oligo-, and poly-saccharides.
- 850. Selected Topics in Food Science**  
 Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.  
 Advanced studies; food utilization, texture, additives, toxicants, food proteins, ingredient safety, nutrient stability, new processing techniques, flavors, quality control, storage stability, state and federal food regulations.
- 880. Special Problems in Food Science**  
 Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.  
 Investigation of food science areas of special interest to individual graduate students.
- 899. Master's Thesis Research**  
 Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 932. Histological and Chemical Techniques**  
 Winter. 3(1-6) Approval of department.  
 Research techniques in thin-layer and gas chromatography, differential thermal analysis, isoelectric focusing, histology, histochemistry, biological testing, polarography and pH stat measurements.
- 933. Instrumental Methods of Analysis**  
 Spring. 3(2-3) FSC 455 or FSC 456 or approval of department.  
 Spectroscopy (ultraviolet, visible, infrared, flame, atomic absorption, fluorescence), manometry, ion exchange, counter-current distribution, radioisotopic tracers.
- 934. Research Techniques with Proteins**  
 Fall. 3(2-3) BCH 401 or BCH 451.  
 Physical and chemical techniques applicable to protein characterization (including—electrophoretic techniques, thin-layer chromatography, gel filtration, ultracentrifugation and amino acid analysis).
- 951. Muscle Biochemistry**  
 Spring. 3(3-0) BCH 451 or approval of department.  
 The structure and function of living muscle. Emphasis is placed upon the chemical and energy changes of muscle in contraction. Changes occurring after death during rigor development are also discussed.
- 952. Advanced Lipids**  
 Winter of even-numbered years. 3(3-0) FSC 402 or approval of department.  
 A course relating composition, structure, and physical and chemical properties of lipids to processing requirements of fats and oils to their function in food systems.
- 953L. Laboratory-Food Enzymology**  
 Spring of even-numbered years. 2(0-4) FSC 953 or concurrently or approval of department.  
 Research methods in the isolation, purification, and characterization of food enzymes and the use of food enzymes in food industries.
- 990. Food Science Seminar**  
 Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits toward M.S. and 6 credits toward the Ph.D. Approval of department.  
 Preparation and presentation of reports on a specialized aspect of research findings in food science.
- 999. Doctoral Dissertation Research**  
 Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**Descriptions — Food Science and Human Nutrition  
of  
Courses**

**Human Nutrition  
and Foods**

**HNF**

**100. Elementary Food Preparation**  
*Fall, Winter, Spring. 4(2-4)*

Composition and properties of food related to quality characteristics; methods of preparation, evaluation of quality and use of selected foods.

**101. Food and Society (N)**

*Fall, Winter, Spring. 3(3-0) Interdepartmental with and administered by Food Science.*

Analysis of the scientific, social and environmental aspects of food in determining the quality of human life. Introduction into the principles of food preservation and safety.

**102. Nutrition for Humans (N)**

*Fall, Winter, Spring, Summer. 3(3-0)*

Fundamentals of nutrition with reference to diverse ways people provide for and attach meaning to food.

**200. Physical and Chemical Properties of Foods**

*Fall, Winter. 4(2-4) CEM 141B or concurrently.*

Interrelationships between basic physical and chemical principles and food preparation: composition, methods of preparation, evaluation, quality standards and comparative analysis.

**205. Food Laws and Regulations**

*Spring. 3(3-0) Interdepartmental with and administered by Food Science.*

Food laws and regulations that govern food processing and food service systems; procedures involved in adopting and enforcing food laws and regulations.

**221. Food and the Consumer**

*Fall, Winter, Spring. 3(3-0) Sophomores or approval of department.*

Factors affecting the food supply, consumer protection, food buying and management of human and material resources in feeding the family.

**222. Food and the Consumer Laboratory**

*Winter. 2(0-4) HNF 221 or concurrently.*

Decision making in Foods and Nutrition with emphasis on food choices in the marketplace. Management of human and nonhuman resources in food consumerism activities.

**290. Professional Literature I**

*Fall, Spring. 2(2-0) HNF 102 or HNF 100 or HNF 200 or FSC 101, Sophomores; departmental majors.*

Identification of factors and development of analytical skills involved in evaluating and communicating scientific information.

**300. Experimental Foods**

*Winter, Spring. 4(2-6) HNF 200, CEM 143; FSC 310 or concurrently.*

Experimental approach to the study of foods, relating chemical and physical properties to reactions and processes occurring in food in response to various treatments.

**310. Sensory Assessment of Foods**

*Winter. 2(1-2) HNF 290, HNF 300 or concurrently.*

Sensory perception, chemistry of food flavors, and methods used in organoleptic evaluation of foods.

**312. Nutrient Composition of Foods**

*Winter. 1(0-2) HNF 102 or FSC 101.*

Sources of nutrient composition information and their use in menu planning. Choosing foods to meet nutrient needs of various groups.

**315. Consumer Aspects of Food Consumption**

*Fall. 3(3-0) HNF 102 or FSC 101; EC 200.*

Economic issues of concern to consumers in the food marketplace; human resource allocation to consumer food consumption activities; federal food programs affecting consumers' nutritional status.

**330. Nutrition in the Life Cycle: Children**

*Winter. 3(3-0) HNF 102; FCS 262A, three terms of natural science or approval of department.*

Functions and importance of nutrients to physical growth, development and health of the child. Eating behavior of children. Feeding in child care centers.

**375. Community Nutrition**

*Fall. 3(3-0) HNF 102 or approval of department.*

Identification of nutritional needs of population groups and available resources in communities.

**379. Basic Nutritional Counseling**

*(478.) Fall, Winter. 3(2-3) HNF 102, CEP 450 or concurrently or approval of department.*

Competencies required of professional dietitians. Skills in communicating, interviewing, problem solving and planning for nutritional care using simulated situations.

**400H. Honors Work**

*Fall, Winter, Spring, Summer. 1 to 16 credits. May reenroll for a maximum of 24 credits. Seniors, approval of department.*

**403. Fats and Carbohydrates in Food Systems**

*Fall. 4(3-3) HNF 300 or approval of department.*

Chemical and physical reactions in fat and carbohydrate food systems, including sols, gels, emulsions, etc. Food evaluation techniques will be introduced.

**404. Role of Proteins in Food Systems**

*Winter. 4(3-3) HNF 300 or approval of department.*

Physical and chemical reactions with protein foods, meats, eggs, cheese, seeds. Emphasis on time-temperature data in relation to quality.

**406. Cultural Aspects of Food**

*Spring, Summer of odd-numbered years. 3(3-0) Juniors.*

A cross cultural investigation of food and its consumption. Factors such as history, religion, food sources and socio-economic status are considered.

**406L. Laboratory—Cultural Aspects of Food**

*Spring. 1(0-3) HNF 100 or HNF 200 or approval of department; HNF 406 concurrently.*

Art and science of cookery in relation to historical, national, regional, racial and religious customs.

**407. Interactions of Culture and Nutrition**

*Spring. 3(3-0) Juniors; HNF 102 or ANP 171 or approval of instructor. Interdepartmental with the Department of Anthropology.*

World and U.S. food behavior focusing on conflicts between behavior and nutritional needs at various stages of life cycle. Anthropological, psychological and social influences affecting food behavior are analyzed.

**411. Principles of Human Nutrition**

*Spring. 4(4-0) BCH 200.*

Identification, function and food sources of nutrients required by humans. Metabolism as affected by deficiency or excess of specific nutrients.

**440. Foodservice Management: Material Resources**

*Fall. 4(4-0) HNF 200, CPS 115 or CPS 130 or concurrently, FSC 310 or approval of instructor.*

Principles, processes and control strategies in non-commercial foodservice operations. Menu planning, procurement, on-premise storage and issue, production, consumer distribution, safety, and sanitation.

**440P. Foodservice Management: Material Resources Practicum**

*Winter, Spring. 3(1-6) HNF 440 or concurrently or approval of department.*

Receiving, storage, preparation and service of food along with safety, sanitation, design and layout of equipment in a noncommercial foodservice operation.

**441. Foodservice Management: Financial Resources**

*Winter. 4(3-2) HNF 440.*

Costs of human and material resources in a non-commercial foodservice operation utilizing manual and electronic data processing strategies.

**442. Foodservice Management: Problem Analysis and Decision Making**

*Spring. 3(2-3) HNF 441.*

Problem-solving techniques. Cause and effect factors, situational components, and development of alternative solutions to problems in non-commercial foodservice.

**461. Energy Nutrients and Proteins for Human Nutrition**

*Fall. 4(4-0) BCH 200; PSL 432 or PSL 241.*

Metabolism of protein, fats and carbohydrates as applied to the nutritional requirements and food supplies of people.

**462. Vitamins and Minerals for Human Nutrition**

*Winter. 4(4-0) HNF 461.*

Metabolism of vitamins and minerals as applied to the nutritional requirements and food supplies of people.

**463. Nutrition and Human Development**

*Winter. 4(3-2) HNF 462 or approval of department.*

The role of nutrients in physiological systems and biochemical processes as related to the perspective of human growth and development.

**470. Clinical Nutrition**  
Spring. 3(3-0) HNF 462; PHM 350 or approval of department.

Changes in physiological and/or biochemical functions or processes due to illness and uses of modified diets as an essential part of treatment.

**470P. Clinical Nutrition Practicum**

Spring. 1(0-2) HNF 470 concurrently.

Assessment of nutritional status. Modification of the hospital general menu for implementation of diets prescribed for treatment of disease.

**473. Interpretation of Clinical Laboratory Tests in Diabetics**

Spring. 4(3-2) HNF 470 or concurrently.

Principles, procedures and interpretation of clinical laboratory methods with particular emphasis on their interpretation relative to nutritional status and therapeutic nutrition.

**479. Dietetics: Theory-Practice Interrelationships II**

Spring. 3(2-3) HNF 379, HNF 441 or concurrently or approval of department.

Continuation of HNF 379. Development of skills in nutritional and employee counseling, resource management and professional behavior using simulated and real life situations.

**490A. Professional Literature II: Foods**

Fall. 2(2-0) HNF 290, HNF 300 or HNF 403 or approval of department.

Selected topics in foods research. Emphasis on experimental data and basic scientific principles related to food quality, nutritive stability and food safety.

**490B. Professional Literature II: Nutrition**

Spring. Summer of even-numbered years. 2(2-0) HNF 290, HNF 462 or approval of department.

Emphasis on experimental data and scientific principles related to basic nutrition research. Focus on current developments in nutrient requirements, metabolism and interactions

**490C. Professional Literature II: Clinical Nutrition**

Spring. 2(2-0) HNF 290, HNF 470 or concurrently or approval of department.

Selected topics in clinical nutrition research. Emphasis on human investigative data and scientific principles related to nutritional care of patients/clients including pathophysiologic correlations, nutritional assessment, diet planning, nutrition counseling.

**490D. Professional Literature II: Foodservice Management**

Winter. 2(2-0) HNF 290, HNF 441 or approval of department.

Examination of trends, problems and research in food service systems operation. Focus on current issues and developments relating to materials handling, labor needs, operational accountability and public responsibility.

**490E. Professional Literature II: Foods and Nutrition Information**

Spring. 2(2-0) HNF 290, HNF 411 or HNF 462 or approval of department.

Selected topics in foods and nutrition information. Emphasis on research related to method and effectiveness of nutrition education.

**495. Independent Study**

Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Seniors; approval of department.

Individual study of selected topics in foods, nutrition and food service management under staff guidance.

**498. Field Study**

Fall, Winter, Spring, Summer. 3 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department.

Planned program of research, observation, study or work in selected organizations under staff guidance.

**800. Seminar in Foods and Nutrition**

Fall, Winter, Spring. 1(1-0) HNF 403 or HNF 463.

**802. Seminar in Food Service Management**

Spring. 2 to 4 credits. May reenroll for a maximum of 4 credits. Approval of department.

**805. Experimental Foods III**

Spring. 4(1-9) HNF 404 or approval of department.

Planning, executing, and reporting individual research project. Data collection, evaluation and interpretation to demonstrate understanding of research techniques and attitudes, and an awareness of significant problems in the field.

**813A. Supervised Individual Study in Nutrition**

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 10 credits. HNF 461.

**813B. Supervised Individual Study in Experimental Foods**

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 10 credits. Approval of department.

**813C. Supervised Individual Study in Foodservice Management**

Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 10 credits. Approval of department.

Special studies in facility management, personnel coordination and tools and methods of operational control.

**816. Applied Human Nutrition**

Spring. 3(3-0) HNF 462.

**840. Topics in Nutrition**

Fall, Winter, Spring, Summer. 2 to 3 credits. HNF 462, PSL 432, BCH 401.

Advanced studies in nutrition: assessment and surveillance, community, clinical, growth and development, behavior, infectious disease and environment, oral health, obesity, aging, diet.

**841. Nutrition and Obesity**

Winter of even-numbered years. 2(2-0) One undergraduate course in nutrition, biochemistry or physiology.

Assessment, energy metabolism, and risk factors associated with obesity. Significance of nutrition and other factors for weight control and reduction.

**842. Nutritional Counseling**

Fall of odd-numbered years. 3(2-3) HNF 470 or approval of department.

Provision of nutritional counseling for clients. Assessment, planning, implementation and evaluation of nutritional counseling.

**899. Master's Thesis Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**921. Pathology of Nutritional and Metabolic Diseases**

(HNF 921, LSM 921.) Spring of odd-numbered years. 4(3-2) ANT 420, ANS 525, BCH 452, HNF 462 recommended. Interdepartmental with and administered by the Department of Large Animal Clinical Sciences.

Development, physiopathology and morphologic pathology of nutritional and metabolic diseases including carbohydrate, protein, fatty acid, vitamin and mineral deficiencies, their experimental induction and their medical or economic significance.

**935. Comparative Nutrition—Lipids and Carbohydrates**

(926.) Winter of odd-numbered years. 4(4-0) BCH 452 and a previous course on principles of nutrition. Interdepartmental with the Department of Animal Science.

Regulatory aspects of carbohydrate and lipid metabolism as influenced by nutrition in mammals. Emphasis on normal and abnormal physiological states such as obesity, ketosis and diabetes.

**936. Comparative Nutrition—Protein Metabolism and Developmental Biology**

(927.) Winter of even-numbered years. 4(4-0) BCH 453, PSL 801 or approval of department. Interdepartmental with and administered by the Department of Animal Science.

Protein quality assessment, protein status, protein calorie malnutrition, amino acid metabolism, protein turnover, digestion and absorption, hormonal control of protein metabolism, developmental aspects of protein metabolism and growth.

**937. Comparative Nutrition—Minerals**

(A H 928.) Spring of even-numbered years. 3 credits. BCH 452, PSL 801. Interdepartmental with and administered by the Department of Animal Science.

Forms and location in body, metabolic roles, deficiency and toxicity signs, interrelationships, requirements and biological availability of sources.

**938. Comparative Nutrition—Vitamins**

(A H 929.) Spring of odd-numbered years. 4(4-0) BCH 452, BCH 453 or approval of department. Interdepartmental with the Department of Animal Science.

Advanced concepts in function and metabolism of vitamins; mechanism of action at cellular/molecular level. Biosyntheses, deficiencies, toxicity. Modern approaches to isolation and assay. Use of animal models in research.

**999. Doctoral Dissertation Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**FOOD SYSTEMS ECONOMICS AND MANAGEMENT**

See Agricultural Economics.

**FOREIGN LANGUAGES**

See Linguistics and Germanic, Slavic, Asian and African Languages; and Romance and Classical Languages.