

**Descriptions — Fisheries and Wildlife  
of  
Courses**

- 477. Limnological Methods**  
Winter. 3(0-9) 476 concurrently;  
ZOL 481; ENT 301, 302 recommended. Inter-  
departmental with the Zoology Department.  
Methods and instruments of limnological field  
investigation on lakes and streams.
- 484. Outdoor Environmental  
Education**  
Fall. 4(3-2) Juniors or approval of  
department.  
Using the outdoors as a teaching laboratory for  
ecological studies of plant and animal communi-  
ties. Designed primarily for secondary teachers.
- 485. Environmental Conservation  
Program Design**  
Winter. 3(3-0) Seniors or approval  
of department.  
Materials and methods for integrating environ-  
mental conservation into educational programs  
in schools, nature centers, youth groups and  
communities.
- 801. Seminar in Fisheries and Wildlife**  
Fall, Winter, Spring. 1(1-0)  
Graduate problems and current developments of  
importance.
- 802. Advanced Topics**  
Fall, Winter, Spring, Summer. 1 to 6  
credits. May re-enroll for a maximum of 15  
credits. Approval of department.  
Study of selected advanced topics in detail and  
depth.
- 821. Advanced Stream Ecology**  
Summer. 3 credits. ENT 421 or ap-  
proval of instructor. Given at W. K. Kellogg  
Biological Station. Interdepartmental with and  
administered by the Entomology Department.  
Stream ecosystem energy budget models with  
emphasis on individual projects involving both  
laboratory and field experiments. Particular use  
will be made of artificial streams and locally  
abundant species of aquatic insects.
- 830. Environmental Requirements of  
Fish**  
Winter. 3(3-0) Approval of depart-  
ment.  
Adaptations and responses of fish to environ-  
mental changes; research methods for evaluat-  
ing environmental limitations and effects of  
pollutants on fish growth, reproduction and  
survival. Applications for developing water  
quality criteria.
- 871. Ecology of Fishes**  
Summer. 6 credits. Approval of in-  
structor or ZOL 389 or FW 473. Given at the  
W. K. Kellogg Biological Station. Interdepart-  
mental with and administered by the Depart-  
ment of Zoology.  
Exploration of ecological problems with partic-  
ular emphasis on growth, food and habitat  
selection, population biology and niche relations.  
Field and experimental investigations of fish  
communities.
- 874. Advanced Biological Limnology**  
Fall. 3(4-0) 477, or approval of de-  
partment.  
Historical and current contributions to concepts  
of community structure, energy flow and mat-  
erials cycling in aquatic eco-systems.
- 875. Chemical Limnology**  
Winter. 4(3-3) 476, 477 or approval  
of department.  
Application of analytical chemistry concepts and  
technologies to fundamental chemical mechan-  
isms in natural and polluted water systems.  
Special consideration given to selected hetero-  
geneous equilibria.

- 899. Research**  
Fall, Winter, Spring, Summer. Varia-  
ble credit. Approval of department.
- 940. Quantitative Wildlife Ecology**  
Spring. 3(3-0) Approval of depart-  
ment.  
Fundamentals of population demographics.  
Rates of increase, dynamic and static life  
tables, logistic theory, the Leslie matrix model,  
age specific and time specific parameters. Cur-  
rent hypotheses on mechanisms promoting popu-  
lation stability.
- 999. Research**  
Fall, Winter, Spring, Summer. Varia-  
ble 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**  
Fall, Winter. 3(3-0) Interdepart-  
mental with Human Nutrition and Foods.  
Analysis of the scientific, social and environ-  
mental aspects of food in determining the  
quality of man's life. Introduction into the  
principles of food preservation and safety.
- 211. Introduction to Food Science**  
Spring. 3(3-0)  
Modern food processing, world food problems,  
and the basic characteristics of processed foods.
- 215. World Food Issues**  
Spring. 3(3-0) Interdepartmental  
with and administered by the Department of  
Geography.  
Food resources as related to world distribu-  
tions of population, soil, water, fuel and min-  
erals. Special attention to urbanization, irri-  
gation, and future food needs and global con-  
straints.
- 223. Commercial Food Processing  
Systems**  
Fall. 3(3-0) Interdepartmental with  
and administered by Physical Systems in Agri-  
culture and Natural Resources.  
Processes and systems used in handling, proces-  
sing and distribution of food; the need for  
processing systems and their influence on food  
quality.
- 242. Meats, Poultry and Fishery  
Products I**  
Fall. 3(2-2) Interdepartmental with  
the Animal Husbandry Department.  
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)  
Composition, use, classification and market  
grades, methods of storage and factors affecting  
keeping quality of dairy products.
- 311. Food Processing and  
Preservation**  
Winter, Summer. 4(4-0) CEM 132  
or HRI 245 or approval of department; not open  
to majors in Food Science.  
Effects of processing, packaging and preserva-  
tion on the quality of foods. Demonstrations of  
use of ingredients, evaluation of products and  
results of various processing methods.
- 331. Physical Principles of Food  
Processing**  
Fall, Winter. 4(3-2) 211; MTH 109;  
PHY 239 or approval of department.  
Food preservation by heat, low temperature,  
dehydration and radiation.
- 332. Biological Principles of Food  
Processing**  
Winter. 4(3-3) MPH 200 or ap-  
proval of department.  
Biological problems related to food processing  
including waste disposal, sanitizing and bac-  
tericidal compounds, pesticides and residues,  
plant and animal growth regulators, radio-  
active elements, preservatives and toxicology of  
additives.
- 333. Chemical Principles of Food  
Processing**  
Spring. 4(3-3) 211 and CEM 241  
or approval of department.  
Chemical changes in foods that affect the tex-  
ture, color, flavor, odor, stability, and nutritive  
quality during processing and storage.
- 400. Milk Processing Technology**  
Fall. 4(3-3) CEM 132 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) 440 and organic chem-  
istry or approval of department.  
Physical, microbiological and chemical proce-  
dures in utilizing microbial cultures in con-  
trolled fermentations of foods and food con-  
stituents.
- 402. Chemistry and Technology of  
Lipids**  
Winter. 3(2-3) 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.
- 404. Dehydrated Foods**  
Spring. 3(2-3) 331; 333 concurrent-  
ly or approval of department.  
Concentration and dehydration of foods by roller,  
spray, and freeze drying and foam, puff and  
tunnel drying. Stability and nutritional aspects  
of dehydrated foods.
- 405. Chemistry and Technology of  
Dairy Products Manufacturing**  
Winter. 3(2-3) May re-enroll for a  
maximum of 6 credits if a different topic is  
taken. 400 or approval of department.  
Physical, chemical and microbiological factors  
in the processing of dairy products. Ice cream,  
sherberts, ice milks and special frozen desserts  
are studied in odd-numbered years; cheese, and  
related dairy products in even-numbered years.
- 421. Food Plant Management**  
Spring. 3(2-3) Seniors or approval  
of department.  
Efficiency concepts, merchandising, personnel  
utilization and organization.

- 440. Food Microbiology**  
(MPH 371.) Fall, Dietetics majors only. Spring. 5(3-4) MPH 200 or 301 or 401, 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.
- 445. Meat, Poultry and Fishery Products III**  
Spring. 3(1-6) 333 or approval of department.  
Processing, formulation and quality control.
- 448. Fruit, Vegetable and Cereal Products I**  
Fall. 4(3-3) 331 or approval of department.  
Quality factors involved in canning, sugar and salt preservation and milling.
- 449. Fruit, Vegetable and Cereal Products II**  
Winter. 4(3-3) 331 or approval of department.  
Quality factors involved in cooling, freezing and other preservation procedures.
- 455. Food Analysis I**  
Fall. 4(2-4) CEM 132 and 162 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 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 quality control within the food industry by case study. Use of control charts, sampling plans, flavor panel analyses.
- 480. Special Problems in Food Science**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll 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.
- 828. Food Processing Concepts, Systems and Selected New Processes**  
Winter. 3(3-0) 331, 332 or 440, or approval of department.  
Concepts of and requirements for processing systems and continuous processes. Use of computers in food processing; microwave heating of foods; radiation preservation of foods and related processing methods.
- 830. Thermal Processing of Food Products**  
Winter. 4(3-3) 331; 332 or 440, or approval of department.  
Heating and cooling characteristics of foods in containers, thermal resistance of microorganisms, and derivation of process times and temperatures for pasteurization and sterilization.
- 832. Microbiology of Food Processing**  
Winter. 3(2-3) 440 or approval of department.  
Control of food spoilage and food poisoning microorganisms in food processing and the role of bacterial spores in process selection.
- 833. Advanced Food Plant Management**  
Fall of even-numbered years. 3(3-0) 421 or approval of department.  
Advanced concepts and strategy of policies and practices in the management of food plants.
- 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 year. 3(3-0) 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 re-enroll 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 re-enroll for a maximum of 12 credits. Approval of department.  
Investigation of food science areas of special interest to individual graduate students.
- 899. 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) 455 or 456 or approval of department.  
Spectroscopy (ultraviolet, visible, infrared, flame, atomic absorption, fluorescence), manometry, ion exchange, counter-current distribution, radio-isotopic tracers.
- 934. Research Techniques with Proteins**  
Fall. 3(2-3) BCH 401 or 451.  
Physical and chemical techniques applicable to protein characterization (including — electrophoretic techniques, thin-layer chromatography, gel filtration, ultracentrifugation and amino acid analysis).
- 951. Muscle Chemistry**  
Spring of odd-numbered years. 3(2-3) 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) 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.
- 953. Enzyme Reactions**  
Spring of even-numbered years. 4(3-3) BCH 451, or approval of department.  
Comprehensive discussion of parameters which affect enzyme activity. Properties of enzymes important in food processing.
- 954. Chemistry of Plant Products**  
Fall of even-numbered years. 3(3-0) 333, BCH 451, or approval of instructor.  
Chemistry and biochemistry of plant pigments, tannins, toxins and proteins.
- 990. Food Science Seminar**  
Fall, Winter, Spring. 1(1-0) May re-enroll 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. Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**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**  
Fall, Winter. 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 man's life. Introduction into the principles of food preservation and safety.
- 102. Nutrition for Man**  
Fall, Winter, Spring. 3(3-0)  
Fundamentals of nutrition with reference to diverse ways man provides for and attaches meaning to his food.
- 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. Laboratory for Food Management**  
Fall, Winter, Spring. 2(0-4) 221 concurrently.  
Planning, organizing, preparing and serving meals with consideration of human and material resources as well as nutrient needs.

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

**301. Dynamics in Dietetics I**

Fall. 2(0-4) Approval of department, 461 concurrently.

Basic knowledge and experience in the functions and responsibilities of the professionally qualified dietitian. Local field trips required.

**302. Dynamics in Dietetics II**

Winter. 2(0-4) Approval of department, 301, 320 or concurrently and 462 concurrently.

Principles and practices in the duties of professionally qualified dietitians with focus on providing food service for groups and nutritional care for patients and/or clients. Local field trips required.

**303. Dynamics in Dietetics III**

Spring. 2(0-4) 302; 470 concurrently.

Principles and practice of instructional design and instruction applied to problems in dietetics. Local field trips required.

**320. Food Service Systems**

Fall, Winter. 5(3-4) 221. Juniors.

Management of food service systems with varying organizational patterns and objectives. Emphasis on human and material resources and their interrelationships in quality food production and service.

**340. Experimental Foods**

Fall. 4(2-4) CEM 132; MPH 200 or concurrently.

Physical and chemical changes occurring in foods during storage, preservation and preparation in terms of palatability, microbial safety and nutritive value. Emphasis on carbohydrates and fats.

**341. Experimental Foods**

Winter. 4(2-4) 340.

Continuation of 340. Emphasis on proteins.

**400H. Honors Work**

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 16 credits. Seniors, approval of department.

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

Fall. 4(3-3) 341 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) 341 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) 100 or 340 or approval of department; 406 or concurrently.

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

**407. Patterns of Food Selection**

Fall. Summer of even-numbered years. 3(3-0) 411 or 461.

Sociological and psychological factors influencing food choices. Evaluation of dietary habits in relation to nutritional needs of individuals.

**409. Presentations in Foods and Nutrition**

Winter. 4(2-4) 340; 411 or 461.

Principles and techniques of presenting foods and nutrition information as applied to teaching or promotional work.

**411. Principles of Human Nutrition**

Winter, Summer. 4(3-2) BCH 200.

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

**453. Readings in Nutrition**

Winter. Summer of odd-numbered years. 3(3-0) 462 or approval of department.

A study of recent developments in research in human nutrition.

**454. Readings in Foods**

Fall. Summer of even-numbered years. 3(3-0) 340 or approval of department.

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

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

Fall. 4(4-0) BCH 200; PSL 332 or 241.

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

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

Winter. 3(3-0) 461.

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

**463. Nutrition and Human Development**

Winter. 3(3-0) 461.

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

**469. Physical and Physiological Growth of Children**

Winter, Spring. 4(4-0) 102; three terms of natural science. Interdepartmental with and administered by the Department of Family and Child Sciences.

Physical and physiological growth patterns. Experimental evidence for nutritional requirements. Applications to feeding practices, and physical activity of children.

**470. Clinical Nutrition**

Spring. 4(4-0) 462.

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

**473. Clinical Chemistry in Dietetics**

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

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

**475. Community Nutrition**

Spring. 4(3-3) 462 or approval of department.

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

**480. Practice of Dietetics**

Fall, Winter, Spring, Summer. 12(2-30) May re-enroll for a maximum of 24 credits. 303, 470.

Application and integration of nutritional and managerial concepts related to the practice of dietetics.

**495. Independent Study**

(I A 400.) Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll 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. 4 to 12 credits. May re-enroll 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) 403 or 463.

**802. Seminar in Food Service Management**

Spring. 2 to 4 credits. May re-enroll for a maximum of 4 credits. Approval of department.

**803. Problems in Food Service Management**

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

**805. Experimental Foods III**

Spring. 4(1-9) 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. Special Studies in Nutrition**

Fall, Winter, Spring, Summer. Variable credit. 461.

**813B. Special Studies in Experimental Foods**

Fall, Winter, Spring. Summer of odd-numbered years. Variable credit. 404; BCH 200 or 451 and 804.

**813C. Special Studies in Food Service Management**

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

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

**816. Applied Human Nutrition**

Spring. 3(3-0) 462.

**825. Techniques in Nutrition Research**

Winter of odd-numbered years. 1 to 3 credits. CEM 333; approval of department. Interdepartmental with and administered by the Animal Husbandry Department.

Use of specialized instruments and techniques. Laboratory safety. Management of laboratory animals. Development of abilities in areas of particular interest to individual students.

**899. Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**926. Comparative Nutrition — Lipids and Carbohydrates**  
Winter of odd-numbered years. 4(4-0)  
BCH 452 and a previous course on principles of nutrition. Interdepartmental with the Department of Animal Husbandry.

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.

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

Winter of even-numbered years. 4(4-0)  
BCH 452, PSL 802 or concurrently. Interdepartmental with Animal Husbandry Department. 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.

**928. Comparative Nutrition — Minerals**

Spring of even-numbered years. 3 credits. BCH 452, PSL 802. Interdepartmental with and administered by the Animal Husbandry Department.

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

**929. Comparative Nutrition — Vitamins**

Spring of odd-numbered years. 3(3-0)  
BCH 452 and a previous course on principles of nutrition. Interdepartmental with and administered by the Animal Husbandry Department.

Chemical and physical properties, standards of activity, occurrence, metabolic roles, antivitamins, deficiency and toxicity signs, requirements and factors affecting requirements.

**999. Research**  
(F N 999.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

## FOOD SYSTEMS ECONOMICS AND MANAGEMENT

See Agricultural Economics

## FOREIGN LANGUAGES

See German and Russian, Linguistics and Oriental and African Languages, and Romance and Classical Languages.

## FORESTRY FOR

### College of Agriculture and Natural Resources

In 305, 306, 402 and 430, field trips are scheduled for several consecutive days away from the campus for integrated field experience, primarily in the second half of spring term of the junior year, so that these courses must be taken concurrently. This precludes enrollment in other courses during that term. The approximate cost of these field trips is \$200.

**IDC. Resource Ecology and Man**  
For course description, see Interdisciplinary Courses.

**202. Introduction to Forestry**  
Fall, Spring. 3(3-0)

Forestry in its broadest sense, including: historic development, forest growth, protection and management, products, national and world economy and policy. Emphasis on multiple use concepts. One-day field trip required.

**204. Forest Vegetation**  
Fall, Spring. 5(3-4) BOT 205 or approval of department.

Nomenclature, classification, and identification of important trees, shrubs, and herbaceous plants of forest and field.

**220. Plants and Their Environment**  
Winter. 3(3-0) Interdepartmental with Natural Resources.

Fundamental ecological relationships between various climatic, edaphic and biotic environmental factors of the ecosystem and plant response, including structure, function and evaluation of species.

**301. Quantitative Methods for Natural Resources**  
Winter. 4(3-2) MTH 109 or 111.

Collection and analysis of information pertaining to natural resources. Survey design, field procedures, equipment, and analytical techniques.

**304. Forest Ecology**  
Fall. 4(3-3) 204; BOT 205.

The forest is viewed as a biological community. Forest site relationships are quantified by examining the existing physical environment and relating it to the forest species occupying that community.

**305. Silviculture**  
Spring. 4(3-3) 204, 304. Must be taken concurrently with 306, 402 and 430.

Natural and artificial forest reproduction methods; intermediate stand treatments; nontimber aspects of silviculture; field studies of silvicultural methods. Extended field trips required.

**306. Forest Fire Protection and Use**  
Spring. 3(2-3) Juniors or approval of department. Must be taken concurrently with 305, 402 and 430.

Causes and effects of forest fires. Combustion, fire behavior and fire weather. Prevention and control planning and techniques. Fire in forest land management. Extended field trips required.

**309. Wood Technology**  
Fall. 4(3-3)

Structure of wood. Mechanical and physical properties of wood. Wood anatomy and relation to growth.

**402. Forest Inventory**  
(302.) Spring. 4(2-6) 301. Must be taken concurrently with 305, 306 and 430.

Field and office techniques of forest inventory, with primary emphasis on timber resources. Extended field trips required.

**409. Forest Hydrology**  
Fall. 3(3-0) CSS 210.

Hydrologic cycle, with emphasis on soil, water and ground water regimes; instrumentation and measurement of the various components. Effects of forest management on watersheds and water yields.

**410. Forest Tree Improvement**  
Fall. 3(2-2)

Distribution of genetic variation in natural tree populations. Introduction, selection, progeny testing, species hybridization, and polyploidy to obtain superior tree populations.

**411. Tree Physiology**  
Winter. 3(3-0) BOT 301.

The fundamental principles of plant physiology with particular reference to the growth and development of woody plants, and consideration of the influence of genetic and environmental factors on physiological processes in trees.

**424. Forest Soils**  
Spring. 4(3-3) 220 or 304, CSS 210. Interdepartmental with the Department of Crop and Soil Sciences.

Interrelationships of forest site and the growth of forests. Classification and productivity of forest soils. Effects of silvicultural and forest management practices on the soil. Two-day field trip required.

**430. Timber Harvesting and Utilization**  
Spring. 4(3-3) 309. Must be taken concurrently with 305, 306 and 402.

Felling and bucking trees. Log transportation. Log and lumber grades. Sawmill practices. Wood working machinery. Gluing wood, manufacture of pulp, plywood and other board products. Extended field trips required.

**431. Finishing, Preservation and Drying of Wood**  
Winter. 3(3-0) 309.

Properties, selection, application of decorative and protective coatings, wood preservatives and fire retardants. Air and kiln drying of lumber.

**435. Law and Resources**  
Spring. 3(3-0) RD 417 or BIO 440. Interdepartmental with and administered by the Department of Resource Development.

Legal theories, cases, statutes and constitutional considerations are applied to natural resource utilization. Private and public property interests in natural resources are illustrated through case studies of use conflicts.

**432. Methods in Wood Science**  
Spring. 3(2-2) 309.

Application of standard laboratory testing procedures to the evaluation of basic properties of solid wood and wood products. Laboratory exercises in wood microtechnique and wood finishings.

**446. Range Management**  
Winter. 4(4-0) 220 or 304 or approval of department.

Development of range industry; grazing regions and reconnaissance; planning multiple-use management on forest range and watershed.

**450. Natural Resource Administration**  
Fall, Spring. 4(4-0) Seniors. Interdepartmental with the departments of Fisheries and Wildlife, Parks and Recreation Resources and Resource Development and Natural Resources.

Concepts and methods of administering wildlife properties. The legal, economic and social environment. Benefit-cost analysis of management changes. Unit organization, personnel management and accounting. Presents a systems view of administration.

**454. World Forestry**  
Winter. 3(3-0)

Forest resources, forestry practices, and the forest economy throughout the world.