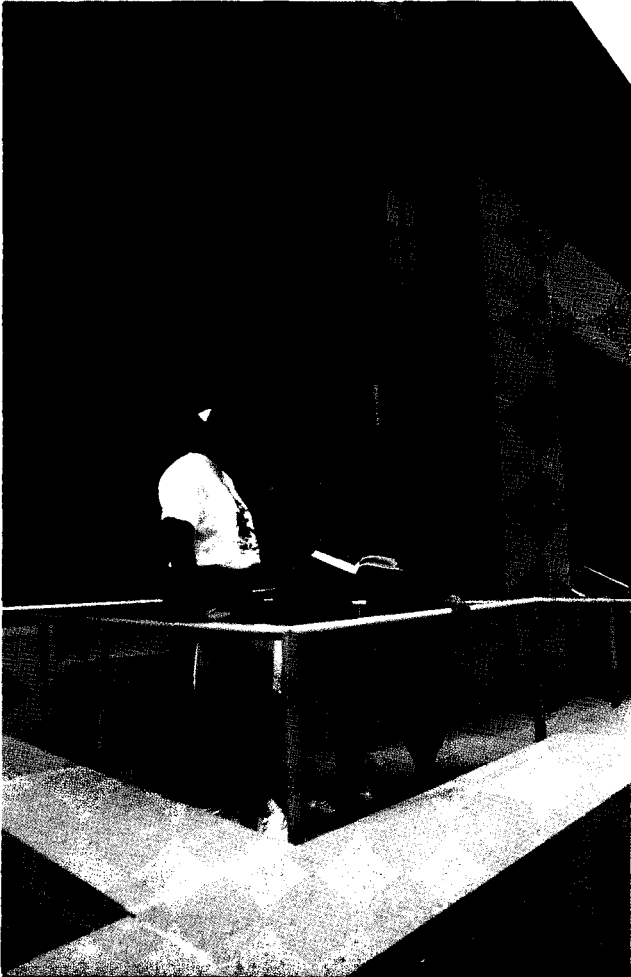


Natural Resources
University of Minnesota Bulletin
1990-92



Natural Resources

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Introduction

Policies

Bulletin Use—The contents of this bulletin and other University bulletins, publications, or announcements are subject to change without notice. University offices can provide current information about possible changes.

Equal Opportunity—The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities and employment without regard to race, religion, color, sex, national origin, handicap, age, veteran status, or sexual orientation. In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota Statute Ch. 363; by the Federal Civil Rights Act, 42 U.S.C. 20000e; and by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by Executive Order 11246, as amended; 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be directed to Patricia A. Mullen, Director, Office of Equal Opportunity and Affirmative Action, 419 Morrill Hall, University of Minnesota, 100 Church Street S.E., Minneapolis, MN 55455, (612) 624-9547; or to the Director of the Office of Civil Rights, Department of Education, Washington, DC 20202; or to the Director of the Office of Federal Contract Compliance Programs, Department of Labor, Washington, DC 20210.

Access to Student Educational Records—In accordance with regents' policy on access to student records, information about a student generally may not be released to a third party without the student's permission. The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, telephone number, dates of enrollment and enrollment termination, college and class, major, adviser, academic awards, honors received, and degrees earned—is considered public or directory information. To prevent release of such information outside the University while in attendance at the University, students must notify the records office on their campus.

Students are notified annually of their right to review their educational records. The regents' policy, including a directory of student records, is available for review at the Williamson Hall Information Center, Minneapolis, and at records offices on other campuses of the University. Questions may be directed to the Office of the Registrar, 150 Williamson Hall (612/625-5333).

Postal Statement

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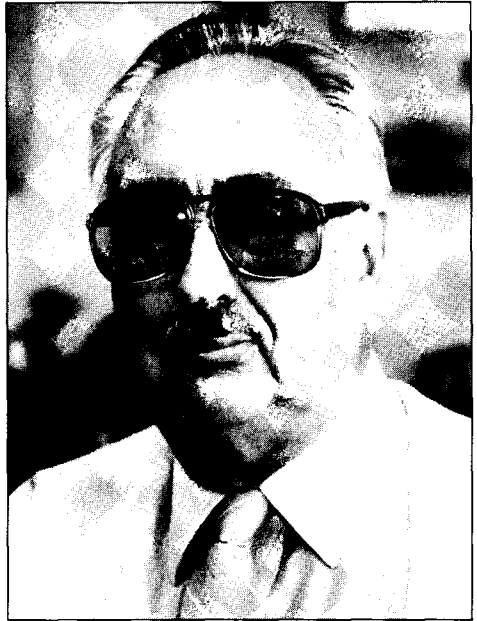
Cover photo by Jeff Christensen.
Black and white photos by Jeff Christensen, Laura Phillips, and Tim Rummelhoff.

Letter from the Dean

The educational opportunities you will find described in this bulletin were developed for students who have a strong interest in the study and understanding of renewable natural resources. The uses, management, and protection of forest, fish, and wildlife resources are the focus of curricula in Forest Products, Forest Resources, Recreation Resource Management, Urban Forestry, and Fisheries and Wildlife. The new program in Natural Resources and Environmental Studies is designed for the student with a general interest in how these various resources relate to serving human needs and to our ability to deal with our environment. These programs are designed to help students integrate scientific knowledge with the management and communication skills necessary for professional success.

Forests, recreation resources, fisheries, and wildlife play important roles in the lives of people worldwide. As a source of firewood or food, physical challenge or psychological reward, these resources touch on the economic, environmental, social, and cultural well-being of each of us. If you would like to help make the most of these renewable resources and to prepare yourself to address the associated environmental issues, I am sure you will find this bulletin presents interesting opportunities.

The College of Natural Resources is recognized nationally for its excellence. It has been accredited continuously since 1935, when forestry program accreditation was first offered. Graduates have played leadership roles in industry, public agencies, research, and education. Our strength is in the quality of our faculty, students, and staff and in the richness of the University as an educational, scientific, and cultural resource.



Richard A. Skok

Richard A. Skok
Dean, College of Natural Resources

Introduction

Placement

Some College of Natural Resources programs offer virtually 100% placement. Forest Products majors, particularly those pursuing a degree in Paper Science and Engineering, find the job market very strong. Starting salaries for these graduates range upward from \$31,000 per year.

Forest Resources graduates also find an expanded job market. Starting salaries for these graduates typically range from \$18,000 to \$23,000 per year. Fisheries and Wildlife graduates face a more competitive job market. Graduates from this curriculum should (1) be flexible in choosing where to work, (2) maintain above average academic records, (3) gain related work experience before graduation, and (4) earn a master's degree. Starting salaries for Fisheries and Wildlife graduates typically range from \$17,000 to \$22,000 per year.

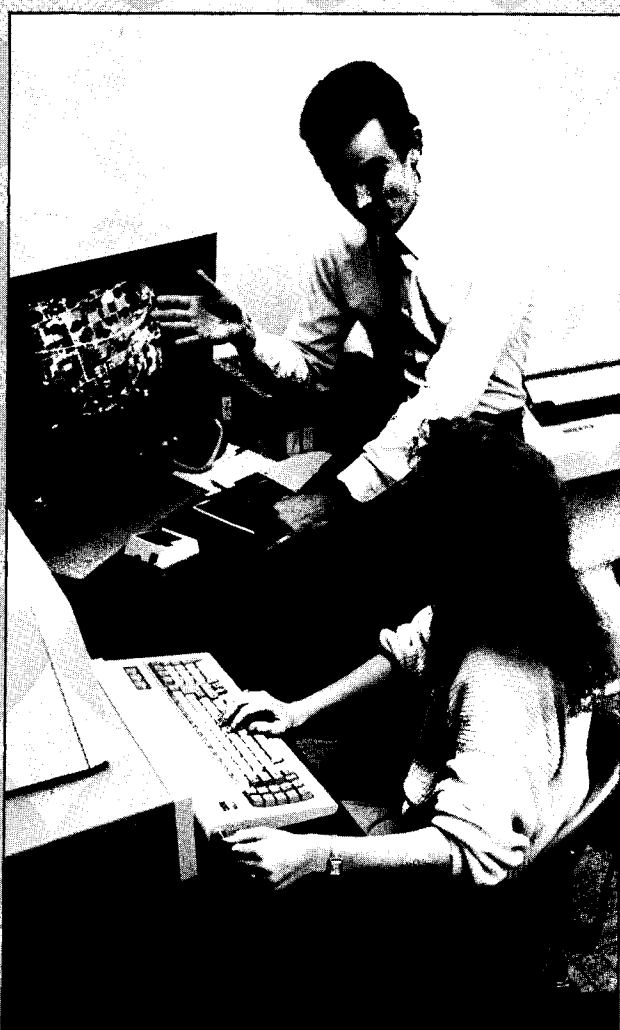
The College of Natural Resources helps students locate summer jobs in fisheries and wildlife, forestry, and forest products industries as well as permanent employment after graduation. Job search assistance for Fisheries and Wildlife and Forest Resources students is provided by the career opportunities coordinator in 135 Natural Resources Administration Building. Students in the Forest Products paper science and engineering specialization receive assistance in 206 Kaufert Lab; all other Forest Products students, in 240 Kaufert Lab. Faculty advise students on job searches, publicize openings, help arrange interviews, and periodically hold information meetings.

Notice to Students

At the time this bulletin goes to press, the Department of Forest Resources and Remote Sensing Laboratory will be in the process of moving back into the remodeled Green Hall from their temporary stay in the Health Services Building. In addition, Green Hall will house offices and a laboratory for some Department of Fisheries and Wildlife faculty and graduate students. These moves will be completed by the conclusion of winter quarter 1990.

This means that many room numbers published in this bulletin for College of Natural Resources facilities as well as faculty and administrative offices may change by the conclusion of winter quarter 1990. For information about new room numbers for College of Natural Resources offices, classrooms, and facilities, please contact the Office for Student Affairs (612/624-6768).

General Information



General Information

Mission

The College of Natural Resources—through its departments of Forest Resources, Forest Products, and Fisheries and Wildlife—seeks to increase the economic, social, and environmental benefits of our most important renewable natural resources. The only institution of higher learning in the state offering B.S., M.S., and Ph.D. programs in these natural resource disciplines, it is engaged in undergraduate and graduate education, basic and applied research, extension, continuing education, and public service.

A recent survey rated the College of Natural Resources among the top forestry schools in the United States. The University of Minnesota has offered a bachelor's degree program in forestry since 1903. Its forestry curriculum is one of only a few in the country to have been continuously accredited by the Society of American Foresters since 1935. Undergraduate and graduate degrees in fisheries and wildlife science have been offered at the University for nearly 50 years. Curricular programs meet education certification requirements for the fisheries and wildlife professional societies. The Forest Products curriculum is oriented to employment in the private sector in the production and marketing of wood products. The Urban Forestry curriculum addresses the city's high density environment and management of tree cover for functional and aesthetic purposes.

Facilities

The College of Natural Resources is based in four buildings on the St. Paul campus: the Natural Resources Administration Building (NRAB), Green Hall, the Kaufert Laboratory of Forest Products and Wood Science, and Hodson Hall.

The Dean's Office, Office for Student Affairs, Graduate Studies in Forestry Office, Cold Weather Climate Housing

Information Center, Forestry Library, and College of Natural Resources computer laboratory are located in the Natural Resources Administration Building. The Forest Resources Department, Remote Sensing Laboratory, and some Department of Fisheries and Wildlife faculty and graduate student offices will move from the Health Services Building and Hodson Hall respectively, into remodeled facilities in Green Hall during winter quarter 1990. For information about new room numbers for these offices, classrooms, and facilities, please contact the Office for Student Affairs (612/624-6768).

The Forest Products Department is in the Kaufert Laboratory, which has well equipped laboratories for teaching and research in wood products manufacturing, wood chemistry, mechanical testing, biodeterioration, and wood drying. The Department of Fisheries and Wildlife office, library, lecture, laboratory, and faculty facilities are in Hodson Hall. Also on the St. Paul campus, adjacent to college facilities, is the regional headquarters of the North Central Forest Experiment Station of the U.S. Forest Service.

The College of Natural Resources uses several field centers for its programs: The University's *Lake Itasca Forestry and Biological Station* is located in Itasca State Park in north central Minnesota. Minnesota's largest state park embraces 50 square miles of virgin and second-growth forest, bogs, streams, and lakes, including Lake Itasca, the source of the Mississippi River. The station offers housing, dining, library, and laboratory facilities. Fisheries and Wildlife, Forest Resources, and Urban Forestry majors spend a 3½-week summer term at the station studying botany, ecology, fisheries and wildlife techniques, and forest measurement.

The college's *Cloquet Forestry Center* includes more than 3,700 acres of virgin and second-growth timber in a major forest products manufacturing area of

northeastern Minnesota. Forest Resources seniors spend their fall quarter at the center taking 18 credits of field-oriented instruction. Students interact with representatives of local industries and nearby state and federal resource agencies. The center has housing, dining, classroom, laboratory, and library facilities. A nationally known forest wildlife research project is based there.

The 300-acre *John H. Allison Forest*, about 10 miles from the St. Paul campus, is available for field laboratory work throughout the year.

Other field experiences—such as trips to southeastern Minnesota's hardwood forests, the industrial forest lands of the southern United States, and the Lake States' forest products mills and factories—are also available to students.

Degrees Offered

Baccalaureate Degrees—The bachelor of science (B.S.) degree is awarded to College of Natural Resources students who satisfactorily complete 192 required and elective credits in one of five major programs: Fisheries and Wildlife, Forest Products, Forest Resources, Recreation Resource Management, or Urban Forestry. The B.S. degree is awarded to College of Natural Resources students who satisfactorily complete 180 required and elective credits in the Natural Resources and Environmental Studies program. Curricular requirements are fully explained in the Baccalaureate Programs section of this bulletin. The degree may be earned "with distinction" or "with high distinction."

Graduate Degrees—The master of science (M.S.) and the doctor of philosophy (Ph.D.) in Forestry, Fisheries, or Wildlife Conservation, and the master of forestry (M.F.) degrees are offered through the Graduate School in cooperation with the College of Natural Resources. For detailed information, contact the appropriate Director of

Graduate Studies (235 NRAB, 612/624-2774, for Forestry; 200 Hodson Hall, 612/624-3600, for Fisheries and Wildlife) or the *Graduate School Bulletin*. Interested students should apply for admission through the Graduate School, 306 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455 (612/625-3014).

Administration

Undergraduate curricula of the College of Natural Resources are organized within three departments: Fisheries and Wildlife (200 Hodson Hall); Forest Products (203 Kaufert Laboratory); and Forest Resources (Green Hall), which includes the Recreation Resource Management and Urban Forestry programs. The College also offers the Natural Resources and Environmental Studies curriculum. The chief administrator of each department is the department head.

Each department has a Student Scholastic Standing Committee, composed of faculty members, that is responsible for interpreting and administering college policies and requirements regarding admission, transfer of credit, curricula, academic standards, student credit loads, and other academic matters.

The college's Office for Student Affairs, 135 NRAB, provides admission, registration, advising, placement, and other assistance to all undergraduates.

Admission

Undergraduates seeking admission to the College of Natural Resources should apply through the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008). A \$20 nonrefundable application fee is required.

Freshman Admission—Because admission requirements will change as of fall 1991, both the 1990 and 1991

General Information

requirements are listed. High school graduates seeking admission for fall 1990 or fall 1991 must submit scores from the Preliminary Scholastic Aptitude Test (PSAT), Scholastic Aptitude Test (SAT), or American College Test (ACT) along with their high school rank percentile (HSR).

The College of Natural Resources will use the following admission criteria for students seeking admission for fall quarter 1990 and fall quarter 1991:

<i>Formula</i>	<i>Minimum Score</i>
HSR Percentile+PSAT Verbal+PSAT Math	150
HSR Percentile+(SAT Verbal÷10)+(SAT Math÷10)	150
HSR Percentile+(2 x ACT Composite Score)	105

For students seeking admission fall quarter 1990, the following high school courses are required: three years of English, three years of mathematics (including elementary and higher algebra and plane geometry, with trigonometry recommended), and at least one year of natural science.

Students seeking admission for fall quarter 1991 or later, or as transfer students (39 or more quarter credits) fall quarter 1993 or later, will be expected to have completed at least the following courses while in high school (grades 9-12):

- 1) **FOUR YEARS OF ENGLISH** with emphasis on writing, including instruction in reading and speaking skills and in literary understanding and appreciation;
- 2) **TWO YEARS OF SOCIAL STUDIES**, including U.S. history;
- 3) **THREE YEARS OF MATHEMATICS**, including one year each of elementary algebra, geometry, and intermediate algebra;
- 4) **THREE YEARS OF SCIENCE**, including one year each of biological and physical science;

5) TWO YEARS OF A SINGLE SECOND LANGUAGE.

Applicants who attain at least the minimum score and meet course requirements will be admitted routinely. Others will be considered on an individual basis, taking into account factors such as high school performance and educational objectives.

Admission with Advanced Standing—Appropriate credits earned at other accredited colleges and universities or within other units of the University may be applied toward College of Natural Resources programs. Most students find they must transfer before their junior year to meet residence and upper-level course requirements of the College of Natural Resources.

Credits earned through special examination or Continuing Education and Extension may transfer to the College of Natural Resources.

Adult Special Admission—Students may be admitted, after college approval, as adult specials. Such students are not degree candidates, but complete courses to satisfy individual needs.

Financial Aid

Scholarships, grants, loans, and work-study programs available University-wide to eligible students are administered through the Office of Student Financial Aid (210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455, 612/624-1665; or 199 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108, 612/625-9225). Application forms are available from either of these student financial aid offices and from most Minnesota high school guidance offices. Students should apply as soon after January 1 as possible. The ACT Family Financial Statement is the official need analysis document used in selecting financial aid recipients.

Scholarships and awards available only to College of Natural Resources students are listed below. These awards

are administered by the college's scholarship committees. *Awards may vary depending on earnings and availability of funds.* Those available to incoming freshmen and/or transfer students are normally awarded the spring before the academic year of their use. Contact the college's Office for Student Affairs for application information.

College of Natural Resources Scholarships and Awards

Mary Dwight Akers Loan—Sponsor anonymous. Limited loans as needed and approved by the dean. Up to \$1,000 each.

John H. Allison Scholarship—Sponsored by former members of the Beta Chapter, Tau Phi Delta. For students with special interests in forest economics, forest management, and related areas. One \$500 award annually.

Andersen Corporation Scholarships—Sponsored by Andersen Corporation, Bayport, Minnesota. For incoming Forest Products juniors and seniors in the marketing and production management specializations on the basis of academic achievement and professional promise. Three \$1,500 awards annually.

Robert C. Bernard Memorial Scholarship—Sponsored by Mrs. Lori Bernard and family and Georgia Pacific Corporation. Established to financially assist a deserving College of Natural Resources student. One \$1,000 award annually.

Boise Cascade Corporation Scholarship—Sponsored by Boise Cascade Corporation. For upper division Forest Resources students on the basis of professional promise, good character, and academic aptitude. Two \$750 awards annually.

R.M. Brown Scholarship—Sponsored by donations to the College of Natural Resources. For a Forest Resources or Natural Resources and Environmental

Studies senior with a special interest in mensuration or statistics. One \$500 award annually.

Carolind Scholarships—Sponsored by the late Dr. Ralph M. Lindgren. For deserving and outstanding undergraduates. Number per year varies. \$300 to \$400 each.

E.G. Cheyney Memorial Scholarships—Sponsored by the Minnesota Forestry Alumni Association. For juniors or seniors who have demonstrated outstanding ability and improvement in creative writing and speaking skills. One \$300 award annually.

Caleb Dorr Scholarships—Sponsored by the Caleb D. Dorr Fund. For the student in each class with the highest grade point average. Four \$500 awards annually.

Edward A. Everett Memorial Scholarship—Sponsored by the late Edward A. Everett. For upper division forestry students on the basis of financial need, acceptable scholarship, and professional promise. Number per year varies. \$500 each.

Federated Garden Clubs of Minnesota Scholarships—Sponsored by the Federated Garden Clubs of Minnesota. For forestry students on the basis of special interest in Urban Forestry, academic aptitude, and personal attributes. Number per year varies. \$200 each.

Forest Products Marketing Scholarships—Sponsored by the Forest Industry Fraternity of Minneapolis and St. Paul. For deserving and promising Forest Products juniors or seniors in the marketing specialization. One or two \$1,000 awards annually.

Robert L. Goudy Memorial Scholarships—Sponsored by Mr. and Mrs. F.X. Corbett, Georgetown, Colorado. For outstanding incoming Forest Resources transfer students on the basis of academic ability, vocational promise, extracurricular activities, personality, and financial need. Two \$300 awards annually.

General Information

Samuel B. Green Scholarship Medal

Sponsored by the late Mrs. Samuel B. Green in memory of her husband. For the senior with the highest grade point average at the end of fall quarter. One honorary medal annually.

Dayton Kirkham Scholarship

Sponsored by the late Mr. Dayton Kirkham. For entering high school seniors and transfer students on the basis of outstanding academic ability and strong desire to pursue careers in natural resource management. Six or more \$1,000 awards annually.

Oscar L. Mather Scholarship

Sponsored by the Minnesota Federation of Women's Clubs and Mrs. Oscar L. Mather, Madison Lakes, Minnesota, in memory of her husband. Book awarded to a forestry student displaying outstanding scholarship, leadership, and character.

Ken Merriam Scholarship—Sponsored by Dr. Lawrence Merriam. For a physically handicapped and/or Recreation Resource Management junior or senior. Professional promise emphasized. One \$500 award annually.

William R. Miles Scholarship

Sponsored by the William R. Miles Fund. For a Forest Resources junior on the basis of professional promise, character and integrity, academic aptitude, and leadership. One \$500 award annually.

Minnesota Forestry Association Scholarship

Sponsored by the Minnesota Forestry Association. For a junior or senior enrolled in either the Forest Resources or Forest Products curriculum, on the basis of professional promise and academic ability. One \$500 award annually.

C.J. Mulrooney Endowed Memorial Scholarships

Sponsored by WCCO AM and FM Radio and Television. For Forest Products juniors and seniors with a specialization in marketing. One award of \$1,500 or more annually.

Leiton Nelson Scholarship—Sponsored by L.E. Nelson Endowment. For a Forest Resources or Forest Products senior demonstrating outstanding academic ability and strong professional promise. One \$1,200 award available alternate years. (Available to qualified graduate student for interim year.)

Charles Lathrop Pack Awards in Forestry—Sponsored by the Charles Lathrop Pack Foundation. For regularly enrolled undergraduates who write the best essays on current forestry or conservation subjects. Three awards annually of \$300, \$200, and \$100.

Paper Science and Engineering Scholarships—Sponsored by manufacturing and supply companies representing the pulp, paper, and allied support industries, and by Paper Science and Engineering alumni. Administered by the University of Minnesota Paper Science and Engineering Council and the Department of Forest Products. For Paper Science and Engineering students on the basis of academic performance and professional promise. \$500 for freshmen, \$1,000 for sophomores, \$1,500 for juniors, and \$2,000 for seniors—total of \$5,000. Current sponsors include Appleton Papers; Betz Laboratories, Inc.; Blandin Paper Company; Boise Cascade Corporation; Buckman Laboratories, Inc.; Consolidated Papers Foundation, Inc.; Diversey Wyandotte; H.B. Fuller Company Foundation; Henkel Chemical Company; Jefferson Smerfit; Lake Superior Paper Industries; Minnesota Forestry Association; Minnesota Section, Technical Association of the Pulp and Paper Industry (TAPPI); Nekoosa Packaging; North Central Division, Paper Industry Management Association (PIMA); Potlatch Foundation for Higher Education; Nalco Chemical Company; Waldorf Corporation; and alumni and personal contributors.

Robert D. Peterson Writing Skill Award—Sponsored by the Robert D. Peterson Award Fund. Open to all sophomores, juniors, and seniors. Recognizes outstanding effort and ability related to communication skills. One \$1,000 award annually.

Pheasants Forever, McLeod County Chapter Scholarship—Sponsored by the McLeod County, Minnesota, Chapter of Pheasants Forever. For seniors in Fisheries and Wildlife on the basis of academic achievement and professional promise. One \$1,000 award annually.

A.G. Roan Scholarship—Sponsored by Mrs. A.G. Roan and family. Available to a junior or student demonstrating a strong conservation ethic. One \$500-\$1,000 award annually.

Henry Schmitz Forest Products Engineering Scholarship—Sponsored by Dr. Stanley J. and Mertie W. Buckman, Memphis, Tennessee. For a Forest Products junior or senior on the basis of academic achievement and professional promise. One \$1,000 award annually.

Henry Schmitz Student Leadership Awards—Sponsored by Dr. Stanley J. and Mertie W. Buckman, Memphis, Tennessee. For juniors or seniors on the basis of demonstrated leadership and acceptable scholarship. Up to four \$300 awards annually.

Augustus L. Searle Scholarship—Sponsored by Augustus L. Searle. For women in the college with preference given to Minnesota residents. Number per year varies. \$500 each.

J. Donald Smith Award—Sponsored by J. Donald Smith Memorial Fund. Book awarded to a senior in Fisheries and Wildlife on the basis of academic achievement and professional promise.

Society of American Foresters (S.A.F.) Scholarship—Sponsored by S.A.F. Recognizes leadership and professional promise. For senior S.A.F. student members. One \$500 award annually.

K.E. Winsness Scholarship—Sponsored by family and friends of the late Professor Winsness. For a junior or senior in the College of Natural Resources who is pursuing a degree while coping with unusual hardships. One \$500 award annually.

Helen A. Young Memorial Scholarship—Sponsored by John Young, Rochester, Minnesota. To help qualified, competent, and needy students start and complete their forestry education. One \$200 award annually.

Student Activities

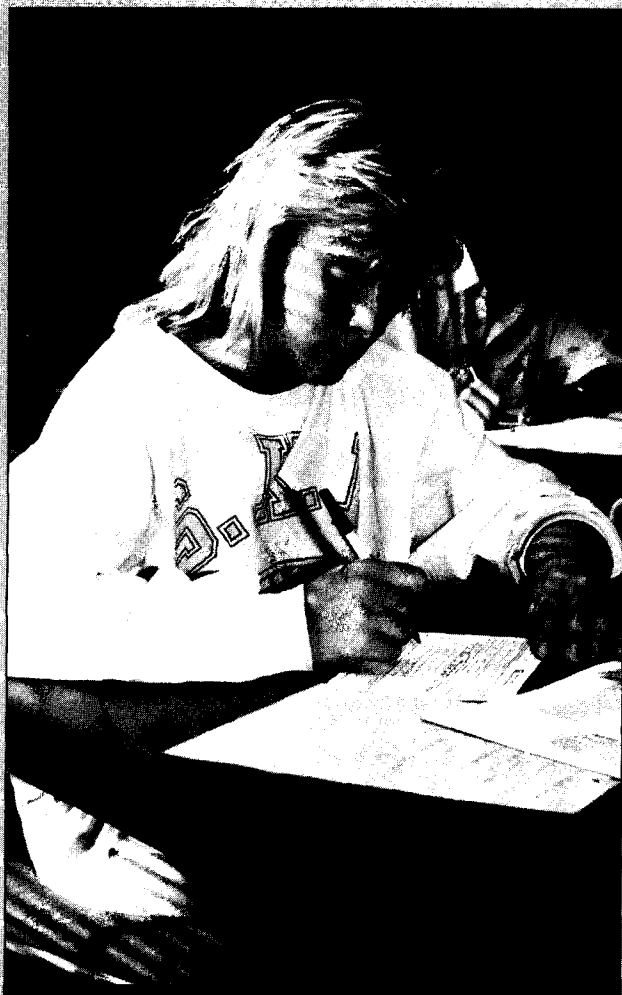
Governance—Students may participate in governance activities at the department, college, and campus levels. Within each department, several committees (including curriculum committees) have student representatives. Students also serve on College of Natural Resources committees and on the college's Student-Faculty Board, which advises the dean on student problems and concerns. Students also participate in the St. Paul Campus Board of Colleges, which directs student activities and acts as a liaison between the student body and administration, and on the Student Center Board of Governors, which establishes programs, operation policies, and budgets for the St. Paul Student Center.

Clubs—Student clubs in the college include the Forestry Club, student chapter of the Society of American Foresters, Recreation Resource Management Club, Forest Products Research Society, Technical Association of the Pulp and Paper Industry (TAPPI), Paper Industry Management Association (PIMA), and Fisheries and Wildlife Club (with an affiliated student chapter of the Wildlife Society). Through these clubs, students hold an annual Forester's Day and a spring picnic, support a scholarship fund by selling Christmas trees, attend events such as the Midwest Fish and Wildlife Conclave and the Midwest-

General Information

ern Foresters Conclave, and produce and market wood identification kits. Xi Sigma Pi Honor Society holds an annual banquet and administers a student speakers bureau. College of Natural Resources students also produce the last remaining University yearbook, the *Gopher Peavey*.

Baccalaureate Programs



Baccalaureate Programs

Six Major Curricula

The College of Natural Resources offers six major curricula leading to the bachelor of science (B.S.) degree: (1) Fisheries and Wildlife; (2) Forest Products (with specializations in marketing, production management, paper science and engineering, and wood science); (3) Forest Resources; (4) Natural Resources and Environmental Studies; (5) Recreation Resource Management; and (6) Urban Forestry. Because the first year of coursework is somewhat similar, students may transfer between curricula at the end of their freshman year with little loss of credit.

Academic Policies

Adviser—Each student, with adviser assistance, is responsible for studying curricular and graduation requirements and developing a course program and timetable to meet them. Freshmen and first-year transfer students in the Forest Resources, Fisheries and Wildlife, Natural Resources and Environmental Studies, Recreation Resource Management, and Urban Forestry curricula are assigned an adviser in the college's Office for Student Affairs. Forest Products students are assigned a faculty adviser within that department.

Credit Load—The typical course load for each quarter is 14 to 18 credits, but may vary according to individual ability and circumstances. A credit requires an average of three hours of work per week, including class, laboratory, and preparation time. To carry more than 21 credits, a student must have at least a B average the previous quarter and permission from the department Student Scholastic Standing Committee.

Repeating Courses—Students may repeat a course even if a passing grade was received. The grade received for the course the second time becomes the permanent grade. The original grade and credits are not included in the

student's cumulative number of completed credits or grade point average. It is the student's responsibility to report any repeated courses to the Office for Student Affairs.

Auditing—Students who audit a course pay regular tuition and fees, but do not take examinations or earn grades or credits.

Extra Credit—Students may register for one to three extra credits in some courses with the instructor's approval. The extra work is mutually agreed upon and conducted independently of class. Contact the Office for Student Affairs for more information.

Independent Study—With the instructor's approval, students may take regularly offered courses through independent study without attending class. Contact the Office for Student Affairs for more information.

Class Attendance—When students willfully miss class, instructors are under no obligation to help them make up work. However, the following reasons justify absences and make-up requests: (a) illness certified by the University Health Service or another physician; (b) death or serious illness in the immediate family; (c) participation, certified by the Office for Student Affairs (190 Coffey Hall), in University-approved cocurricular activities; and (d) approval of the absence by the department Student Scholastic Standing Committee, which becomes involved only in emergencies or as an appeal agency.

Class Standing—Students are classified according to the number of credits they have completed: freshmen—45 or fewer credits, sophomores—46 to 90 credits, juniors—91 to 135 credits, seniors—136 or more credits. Freshmen and sophomores are considered lower division; juniors and seniors, upper division.

Registration—The quarterly *Class Schedule* contains general registration instructions.

Forest Resources and Forest Products juniors and seniors and Fisheries and Wildlife majors may sign their own course request forms. All other students in the college, regardless of class standing, must have their advisers sign their registration materials.

Students who find it necessary to cancel or add courses after registering for the quarter should contact the Office for Student Affairs for instructions and forms.

During the first week of the quarter, a course may be added to a student's schedule without any approval required (if the course is open). During the second through the sixth week, the instructor's permission is required, and after the sixth week the approval of both the adviser and the department Student Scholastic Standing Committee is required.

During the first six weeks of a quarter, no approval is required to cancel a course with a W (withdrawal). During the third through the sixth week, the instructor's permission is required. After the sixth week the approval of the adviser, instructor, and department Student Scholastic Standing Committee is required. A student doing passing work may be permitted to cancel a course after the sixth week with a W; if the student is doing failing work, an F (no credit) will be reported.

If a student withdraws from the college at any time, all classes should be officially cancelled. Cancellation through the first three weeks entitles the student to a refund (a 100% refund through the first week, 75% through the second week, and 50% through the third week).

Grading—Two grading options, A-B-C-D-F and S-N, are offered, although use of the S-N option is limited. A grading option is chosen for each course at the time of registration. The following restrictions on the use of the S-N option apply to College of Natural Resources students:

1. A maximum of 25% of the residence credits presented for the baccalaureate degree may be in courses in which a grade of S was received.

2. All required courses must be taken under the A-F option. Prerequisites for required courses and courses in the major must also be taken A-F unless an exception is made.

University grading policies and letter definitions are explained in the quarterly *Class Schedule*.

Honor System—Under an honor system adopted on the St. Paul campus, students accept responsibility for the supervision of student behavior during examinations and pledge not to give or receive aid. A student or faculty member who observes an act of dishonesty may report the incident to the college Honor Case Commission, a committee of the Student-Faculty Board. For more information about how the honor system works, contact the Office for Student Affairs.

Satisfactory Progress—Students in the College of Natural Resources are expected to meet certain minimum academic standards. Students not meeting these standards are subject to probation and suspension actions by their department Student Scholastic Standing Committee. The following chart details conditions under which these actions will be taken:

<i>Probation</i>	Cumulative grade point average (GPA) after first two quarters in college below 1.90 (freshman) or 2.00 (sophomore, junior, senior) or Any combination of three D and N or F grades in any one quarter
<i>Suspension</i>	Cumulative GPA after first two quarters in college below 1.60 (freshman) or 1.90 (sophomore, junior, senior) or Any combination of four D and N or F grades in three consecutive quarters or Two consecutive quarters of probation

Baccalaureate Programs

The Student Scholastic Standing Committee puts a student on probation and informs him/her that repeated low academic performance will lead to a suspension. A suspension action lasts two academic quarters, and reinstatement in the program requires a petition to the department Student Scholastic Standing Committee. Students placed on probation or suspension may appeal the action.

The Itasca session for Fisheries and Wildlife and Forest Resources students is not counted as a separate quarter. Itasca grades are included with the fall quarter grades.

Students who are performing poorly academically should contact their adviser as soon as possible to correct the problem. Probation and suspension actions are rarely waived.

To appeal a suspension action, the student must obtain a "Petition for Reinstatement" from the Office for Student Affairs. The petition must be completed and turned in to the chair of the department Student Scholastic Standing Committee, along with any supporting documents. The final decision rests with the department Student Scholastic Standing Committee, which will act on the petition and inform the student in writing.

Policy Waivers—Occasionally it may be to the educational advantage of both the student and the department to waive an academic policy or curricular requirement, provided the basic spirit of the regulation is maintained. A student may petition for a departure from normal procedure. If approved by the adviser, the petition is routed to the department Student Scholastic Standing Committee for a final decision. Contact the Office for Student Affairs for more information.

Graduation Requirements

To receive the bachelor of science (B.S.) degree, College of Natural Resources students must meet the following requirements:

1. Complete a minimum of 192 credits (180 for Natural Resources and Environmental Studies), including required and elective courses in the chosen curriculum. No more than 9 credits in physical education may be applied toward the degree. No more than 9 credits in music may be applied as elective credits toward the degree, with no more than 6 of these in Mus 1430 or concert band.

2. Achieve a GPA of 2.00 or higher with no more than 5 credits of D in required Forest Resources, Forest Products, Natural Resources and Environmental Studies, or Fisheries and Wildlife designator courses and 5 credits of D in other required courses.

3. Satisfy liberal education requirements (see below).

4. Satisfy residence and other general University requirements for graduation.

Graduation with Honors—The B.S. degree may be earned "with distinction" or "with high distinction." Students who achieve a GPA of at least 3.85 may be recommended to the faculty for graduation with high distinction. The recommendation is made on the basis of scholarship and other evidence of satisfactory achievement in the curriculum. Students who achieve a GPA between 3.35 and 3.85 may be recommended for graduation with distinction.

Transfer students who have completed less than half the credits required for graduation while in residence in the College of Natural Resources are not eligible to graduate with honors.

Quality Credits—The number of free elective credits required for graduation may be decreased by one for every five grade points in excess of those required to reach a GPA of 3.35. Free electives may be chosen without regard to curricular or college requirements. No more than one-twelfth of the total number of credits required for graduation may be gained through quality credits.

Special Examinations for Credit—

Currently enrolled students who believe their knowledge of a subject is equal to that required to complete a particular course may request to take an examination for credit. If the Student Scholastic Standing Committee and the department approve, arrangements can be made with an appropriate instructor to take an examination. Usually no grade is assigned. A \$30 fee is assessed for each examination. Credit by special examination is not granted for language or mathematics courses taken in high school.

College Level Examination Program (CLEP)—

Students may earn credit for the CLEP social science and humanities examinations prepared by the College Entrance Examination Board. CLEP also offers a number of subject examinations for credit. Information may be obtained from the Office for Student Affairs.

Liberal Education Requirements—

The University of Minnesota believes all students, regardless of their area of specialization or vocational goals, should have a broad liberal education. Therefore, in addition to its own curricular requirements, the College of Natural Resources requires coursework in each of four liberal education categories. The minimum number of credits required in each category and a partial list of courses follow. Note that individual College of Natural Resources curricula may require more credits in any of the four categories and place restrictions on which courses to complete and when. Students in doubt about the use of specific courses should consult the Office for Student Affairs.

All College of Natural Resources students must take Rhet 1101, 1151, 1222, 3562 (except that Recreation Resource Management majors may substitute 3551 for 3562), and FW or ForP or FR 1104. Students who pass an English proficiency examination, administered by the Rhetoric Department, may be exempted from Rhet 1101. Students with above average writing

skills may also take exemption examinations, administered once each quarter by the Rhetoric Department, for Rhet 3562. Note that advanced composition courses taken at other institutions can be used to satisfy the Rhet 3562 requirement.

The College of Natural Resources accepts CLEP scores at the 75th percentile or higher for exemption from up to 8 credits in category D and, in special cases by petition, in category C.

A. Communication, Language, Symbolic Systems—26 credits minimum

1. *English and Foreign Language Communication Skills*
Comp 1011, 1012, 1013, 1027
ForP, FR, FW 1104
Rhet 1101, 1151, 1222, 3254, 3266, 3562
Spch 1101, 1102, 3605
2. *Linguistics, Logic, and Philosophic Analysis*
Clas 1048
Ling—all courses except 1005, 3970, 5970
Phil 1001, 1005, 5105, 5201
3. *Mathematics*
Math—all courses except 0009, 1005-1006, 5703
Stat 3011, 3091, 5021

B. Physical, Biological, and Analytical Sciences—25 credits minimum

1. *The Physical Universe*
Ast 1011, 1021
BioC 3001-3031
Chem 1001-1002, 1003, 1004-1005, 1006
Geo 1001, 1002, 1111
Phys 1041, 1042, 1045, 1046, 1271-1281-1291
Soil 1020, 1262
2. *The Biological Universe*
Biol 1008, 1009, 1103, 1106
PBio 1009, 1012
Ent 1005
GCB 3022
Phsl 1002

C. The Individual and Society—8-22 credits minimum, depending on curriculum (with no more than 6 credits in any one discipline)

1. *Analysis of Human Behavior and Institutions*
Afro 1025, 3055, 3061-3062, 3072, 3091
AgEc 1102, 1101
Anth 1102
Econ 1001-1002, 1004-1005, 3001-3002
FR 1201 (except Fisheries and Wildlife)
FSoS 1001, 1025
Geog 1301, 1401
Pol 1001, 1025, 1026, 1027
Psy 1001, 1004-1005
Rhet 5165
Soc 1001, 1002, 3101
Spch 3401
2. *Development of Civilization: Historical and Philosophical Studies*
Afro 1015, 1025, 1441
Clas 1001, 1002, 1003, 1004, 1005, 1006, 1042, 3071, 3072, 3073

Baccalaureate Programs

Fren 3501, 3502
Hist—all courses through 1954
Ital 3501, 3502
Jour 5601
Phil 1002, 3001, 3002, 3003, 3004
Pol 1041
Rhet 1310, 1311, 3375
Span 3501, 3502

D. Literature, Humanities, and Fine Arts—8 credits minimum

1. Literature

Engl—all literature courses
Foreign languages—all literature courses
Rhet—all literature and humanities courses

2. The Arts

Afro 1301, 3105, 3301
Arch 1021, 1022, 1023
ArH—all courses except 5521, 5950, 5960, 5970, 5990, 5991
ArtS—all courses except 3530, 3970, 3980, 5530, 5970
Dsgn 1501, 1521
Mus—all courses except 1052, 1053, 1340, 1351, 1602, 3970, 3980, 5253, 5330, 5340, 5364, 5365, 5540, 5667, 5950
Th—all courses except 3412, 3980, 5321, 5540, 5950, 5970

Itasca Session—Forest Resources, Urban Forestry, and Fisheries and Wildlife majors are required to complete a 3½-week Lake Itasca Forestry and Biological Station summer term between their freshman and sophomore or sophomore and junior years. To attend, students must have completed 40 credits and attained a minimum cumulative GPA of 2.00. Forest Resources and Urban Forestry students must also have completed the following courses with a grade of C or better: Biol 1103, Chem 1001 or 1004, and Math 1008 (students with a C or better in high school trigonometry are exempt from Math 1008). Fisheries and Wildlife students must have completed the following courses with a grade of C or better: Biol 1009, 1103, 1106, and FW 3052. The session is also open to students who are not enrolled in the College of Natural Resources.

All transfer students must provide the Office for Student Affairs with transcripts of all coursework and an application by July 15 before the start of the Itasca session they wish to attend.

Cloquet Session—Students in Forest Resources are required to complete the Cloquet Session in the fall of their senior

year. To attend, students must have attained a minimum cumulative GPA of 2.00 at the end of the preceding quarter and completed the Itasca Session and FR 1100, 3103, 3232, 3300, 5100, 5114, 5200, 5212, 5215, Soils 1020, and FW 3052.

Minnesota-Idaho Student

Exchange—Forest Resources students at the University of Minnesota who are pursuing a management or biological sciences emphasis may study timber harvesting in Idaho during their senior year under an exchange agreement with the University of Idaho. Minnesota students return from this study in Idaho to be awarded their baccalaureate degree from the department of Forest Resources. In turn, Idaho students take coursework in paper science and engineering at the University of Minnesota.

Forest Products Cooperative Education Program

—Students in this program alternate periods of employment in their career fields with periods of academic study. The program leads to a B.S. in Forest Products, with a specialization in paper science and engineering, production management, marketing, or wood science. Full-time students who have declared a major in Forest Products and who have a 2.70 GPA may apply.

Students must complete at least two quarters of academic study before their first quarter of work. At the end of each work quarter, students must submit a written report on their work assignments and learning experiences to a faculty member. Successful reports are graded "S" (satisfactory), and one credit is awarded for completing a work quarter. Continuation of the program is based on indication of normal progress toward the degree, a 2.50 cumulative GPA, and satisfactory work progress. For more information, contact Dr. James Bowyer, Forest Products Department Head, 209 Kaufert Laboratory (612/624-4292).

Fisheries and Wildlife Field Trip—

Fisheries and Wildlife majors are eligible to participate in a field trip during spring break of their senior year. Selection for participation is competitive, based on previous academic performance. Students travel with a faculty member or graduate student(s) to different regions of the United States to observe and discuss ongoing fisheries and wildlife management activities. Local agency personnel provide on-site information.

Fisheries and Wildlife

This curriculum offers basic education in the biological and physical sciences and related nonscience disciplines to provide the broad background necessary for professional careers in fisheries and wildlife, natural resources, and other biological sciences. The program emphasizes basic principles and quantitative approaches to fisheries and wildlife conservation. Undergraduate-level study will satisfy only minimum requirements for professional employment; graduate-level study will enhance career opportunities. (The master's degree is required for many management, administrative, and research positions. The doctorate may be required for some positions and for college teaching.)

All students take the core curriculum of 175-183 credits, including six credits at the Itasca Session and three credits of a senior project, completed as a group activity with classmates over two quarters. The 9-17 elective credits may be used for concentration in a specific field of interest or spread among different disciplines. Electives are chosen in consultation with the student's adviser.

Freshman and Sophomore Years—97 credits

A. Communication, Language, and Symbolic Systems—32 credits

- FW 1104—Library Research Methods (1)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3266—Communication, Discussion, in Small Group Decision-Making (4)

Choose one of the following groups:

- Math 1211, 1221—Calculus I, II (5, 5)
and Math 1241—Linear and Nonlinear
Multivariable Analysis I (5)
or Phil 1001—Introduction to Logic (5)
or Math 1142, 1131, Phil 1001—Short
Calculus, Finite
Mathematics, Introduction to Logic (5,5,5)

B. Physical, Biological, and Analytical Sciences—43 credits

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
- Biol 1106—General Zoology (5)
- Biol 5041—Ecology (4)
- PBio 3201—Introductory Taxonomy (4)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- FR 1201—Conservation of Natural Resources (3)
- FW 1001—Orientation in Fisheries and Wildlife (1)
- FW 1101—Ethics and Values in Resource Management (3)
- FW 3052—Introduction to Fisheries and Wildlife (3)
- C. The Individual and Society—14 credits*
- AgEc 1102—Principles of Macroeconomics (5)
- Pol 1001—American Government and Politics (5)
- Mgmt 3001—Fundamentals of Management (4)
or Mgmt 3002—Psychology in Management (4)
or IR 3010—The Individual in the Organization (4)

D. Literature, Humanities, and Fine Arts—8 credits
See suggestions under Liberal Education Requirements.

Junior and Senior Years—95 credits

Itasca Session—6 credits

- FW 3600—Fisheries and Wildlife Field Techniques (5)
- FR 3106—Identification of Important Plants in Fisheries and Wildlife Habitats (1)

Required Courses—73-80 credits

- GCB 3022—Genetics (4)
- EBB 5608—Ecosystems: Form and Function (3)
or EBB 5014—Ecology of Plant Communities (5)
- EBB 5156—Comparative Animal Physiology (5)
- EBB 5044—Evolution (4)
or VB 1120—Comparative Vertebrate Morphology (6)
- EBB 5601—Limnology (4)
or Geo 1601—Oceanography (4)
- EBB 5136—Ichthyology (4)
or EBB 5606—Ecology of Fishes (3)
- FW 5129—Mammalogy (5)
or EBB 5134—Introduction to Ornithology (5)
- FW 5601—Assessment and Management of Vertebrate Populations (5)
- FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
- FW 5604—Fishery and Wildlife Management (4)
- FW 5701, 5702—Senior Project (1,2 cr)
- BioC 3001—Elementary Biological Chemistry (4)
or Chem 3301, 3305—Elementary Organic Chemistry I and Lab (4,2)
- PubH 5450—Biometry I (4)
- PubH 5452—Biometry II (4)
- Rhet 3562—Writing in Your Profession (4)
- Phys 1041—Introductory Physics (4)
- Phys 1042—Introductory Physics (4)

Baccalaureate Programs

Geo 1111—Introductory Physical Geology (5)
or Geo 1001—Introduction to Geology (4)
and Geo 1021—Introduction to Geology Lab:
Geology of Minnesota (1)

Suggested Electives—9-16 credits

Choose from this list. Unlisted courses may be taken after consultation with the adviser.

EBB 3111—Introduction to Animal Behavior (4)
EBB 5052—Theoretical Population Ecology (4)
EBB 5116—Introduction to Animal Parasitology (5)
Ent 5360—Aquatic Entomology (2)
FR 5100—Silviculture (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (3)
FR 5231—Range Management (3)
FR 5240—Natural Resource Policy and Administration (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5458—Water Quality Management: Ecosystem Approaches (4)
FW 5610—Renewable Natural Resources and Public Policy (2)
FW 5455—Aquaculture (4)
FW 5459—Physiology and Behavior of Fishes (3)
PA 5721—Environmental Policy I (3)

Fisheries and Wildlife Minor

This minor enables majors in the natural resource areas or other fields such as communications and education to develop a secondary concentration in fisheries and wildlife. An overview of fish and wildlife natural history and the general principles applied to managing their populations and habitats is provided. Open to students who have completed the required background courses or their equivalent; the minor is declared once minor core and optional courses are completed.

Required Background Courses—17-19 credits

Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Biol 5041—Ecology (4)
FW 1001—Orientation in Fisheries and Wildlife (1)
One vertebrate biology course from the following:
EBB 5114—Vertebrate Biology (4)
FW 5129—Mammalogy (5)
EBB 5134—Introduction to Ornithology (5)
EBB 5834—Field Ornithology (5) (Itasca)
EBB 5136—Ichthyology (4)
EBB 5606—Ecology of Fishes (3)

Minor Core Courses—14 credits

FW 1101—Ethics and Values in Resource Management (3)
FW 3052—Introduction to Fisheries and Wildlife (3)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fishery and Wildlife Management (4)

Optional Courses—Choose one course

FW 5459—Physiology and Behavior of Fishes (3)
FW 5455—Aquaculture (4)
FW 5601—Assessment and Management of Vertebrate Populations (5)

Forest Products

This curriculum is for students interested in careers in the development, production, marketing, and use of the thousands of products that flow from forests—from paper, wood-based panels, and furniture to chemicals from wood.

Courses emphasize the chemical, physical, and mechanical properties of wood and the newest technologies for converting this raw material into its many final forms.

Marketing—This specialization is for students interested in the marketing, sales, and distribution of forest products. Technical emphasis is on the physical-mechanical nature of wood-based building materials including lumber, plywood, fiberboard, particleboard, and newer composite products. In addition, coursework focuses on marketing principles and analysis, management science, computer applications, and economics. Career opportunities include purchasing and selling of all types of forest products at the wholesale and retail levels, technical sales, product promotion, and specialized marketing research.

Freshman Year—40 required credits

AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (5)
Biol 1009—General Biology (5)
Chem 1001—Chemical Principles and Covalent Systems (5)
Chem 1002—Chemical Principles and Covalent Systems (5)
ForP 1001—Forest Products Orientation (1)
ForP 1104—Library Research Methods (1)
Math 1142—Short Calculus (5)
Psy 1001—Introduction to Psychology (5)
Rhet 1101—Writing to Inform and Persuade (4)
Electives and liberal education requirements

Sophomore Year—44 required credits

Acct 1024—Principles of Financial Accounting I (3)
Acct 1025—Principles of Financial Accounting II (3)
Acct 3001—Managerial Accounting (4)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)
Phys 1041—Introductory Physics (4)
Phys 1042—Introductory Physics (4)
Phys 1045—Introductory Physics Laboratory (1)
Phys 1046—Introductory Physics Laboratory (1)
Jour 1001—Introduction to Mass Communication (2)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Stat 3011—Statistical Analysis (4)
Electives and liberal education requirements

Junior Year—42 required credits

- BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
 - CSci 3101—A FORTRAN Introduction to Computer Programming (4)
 - or CSci 3102—Introduction to Pascal Programming (4)
 - or AgET 3030—Introduction to Problem Solving With Computers (4)
 - ForP 3300—Wood Industry Tours (2)
 - ForP 3303—Forest Products Marketing (3)
 - ForP 3312—Building Materials Estimating (2)
 - ForP 5300—Wood-Fluid Relationships (3)
 - ForP 5301—Mechanical Properties (3)
 - ForP 5303—Wood Deterioration (3)
 - ForP 5331—Undergraduate Seminar (2)
 - Mgmt 3001—Fundamentals of Management (4)
 - Mktg 3000—Principles of Marketing (4)
 - Mktg 3010—Buyer Behavior and Marketing Analysis (4)
 - Mktg 3020—Marketing Operations Management (4)
- Electives and liberal education requirements

Senior Year—34 required credits

- ForP 5304—Wood Drying and Preservation Processes (4)
 - ForP 5307—Wood-Base Panel Technology (4)
 - ForP 5355—Mechanics and Structural Design With Wood Products (4)
 - ForP 5356—Advanced Forest Products Marketing (3)
 - BME 5260—Professional Sales Education (3)
 - BFin 3000—Finance Fundamentals (4)
 - Jour 5251—Psychology of Advertising (4)
 - Mktg 3030—Sales and Distribution Management (4)
 - Rhet 3562—Writing in Your Profession (4)
- Electives and liberal education requirements

Directed Electives—at least two courses

- Acct 3160—Financial Statement Analysis (4)
- Jour 3159—Public Relations (4)
- Jour 5721—Mass Media in a Dynamic Society (4)
- Mgmt 3002—Psychology in Management (4)
- Mktg 3050—Marketing Communications (4)
- Mktg 3065—Retail Management (4)
- LM 3010—Principles of Transportation (4)
- LM 3020—Advanced Logistics Management (4)

Total Graduation Requirements—192 credits
 Required courses and directed electives listed above (168 credits), liberal education requirements in category D (8 credits), and electives (16 credits).

Production Management—This specialization is for students interested in production management careers in industries that manufacture lumber, plywood, particleboard, furniture, and other wood products. In addition to a basic wood science background, students gain knowledge in industrial engineering, labor management, and economics.

Freshman Year—35 required credits

- AgEc 1101—Principles of Microeconomics (4)
- AgEc 1102—Principles of Macroeconomics (5)
- Biol 1009—General Biology (5)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- ForP 1001—Forest Products Orientation (1)
- ForP 1104—Library Research Methods (1)

- Math 1142—Short Calculus (5)
 - Rhet 1101—Writing to Inform and Persuade (4)
- Electives and liberal education requirements

Sophomore Year—41 required credits

- BioC 3001—Elementary Biological Chemistry I (4)
 - ForP 1301—Wood as a Raw Material (4)
 - ForP 1303—Wood Structure and Identification (2)
 - FR 1100—Dendrology (4)
 - Phys 1041—Introductory Physics (4)
 - Phys 1042—Introductory Physics (4)
 - Phys 1045—Introductory Physics Laboratory (1)
 - Phys 1046—Introductory Physics Laboratory (1)
 - Psy 1001—Introduction to Psychology (5)
 - Rhet 1151—Writing in Your Major (4)
 - Rhet 1222—Public Speaking (4)
 - Stat 3091—Probability and Statistics (4)
- Electives and liberal education requirements

Junior Year—43 required credits

- CSci 3101—A FORTRAN Introduction to Computer Programming (4)
 - or AgET 3030—Introduction to Problem Solving With Computers (4)
 - ForP 3300—Wood Industry Tours (2)
 - ForP 3303—Forest Products Marketing (3)
 - ForP 3361—Introduction to Adhesives (3)
 - ForP 5300—Wood-Fluid Relationships (3)
 - ForP 5301—Mechanical Properties (3)
 - ForP 5303—Wood Deterioration (3)
 - ForP 5331—Undergraduate Seminar (2)
 - ForP 5355—Mechanics and Structural Design with Wood Products (4)
 - IEOR 3000—Introduction to Industrial Engineering Analysis (4)
 - IEOR 5030—Quality Control and Reliability (4)
 - IEOR 5040—Introduction to Operations Research (4)
 - IR 3002—Personnel and Industrial Relations (4)
- Electives and liberal education requirements

Senior Year—39 required credits

- ForP 5304—Wood Drying and Preservation Processes (4)
 - ForP 5305—Pulp and Paper Technology (4)
 - ForP 5306—Analysis of Production Systems (3)
 - ForP 5307—Wood-Base Panel Technology (4)
 - IEOR 5010—Introduction to Work Analysis (4)
 - IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
 - IEOR 5311—Management for Engineers (4)
 - IEOR 5361—Inventory and Production Control (4)
 - IR 3007—Collective Bargaining and Labor Relations (4)
 - Rhet 3562—Writing in Your Profession (4)
- Electives and liberal education requirements

Total Graduation Requirements—192 credits
 Required courses listed above (158 credits), liberal education requirements in category D (8 credits), and electives (26 credits).

Paper Science and Engineering—

This specialization provides in-depth training in mathematics, physics, chemistry, engineering, and wood and fiber science and technology. It also includes specialized pulp and paper and related engineering courses on the technology of the pulping and papermaking processes. Graduates find careers in

Baccalaureate Programs

process engineering, manufacturing operations, technical services, marketing, plant management, and research and development.

Freshman Year—44 required credits

AgEc 1102—Principles of Macroeconomics (5)
Chem 1004—General Principles of Chemistry (5)
Chem 1005—General Principles of Chemistry (5)
Chem 1006—Principles of Solution Chemistry (4)
ForP 1001—Forest Products Orientation (1)
ForP 1104—Library Research Methods (1)
Math 1211—Calculus I (5)
Math 1221—Calculus II (5)
Math 1241—Linear and Nonlinear Multivariable Analysis I (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1222—Public Speaking (4)
Electives and liberal education requirements

Sophomore Year—46 required credits

Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Laboratory I (2)
Chem 3306—Elementary Organic Chemistry Laboratory II (2)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or AgET 3030—Introduction to Problem Solving With Computers (4)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
Math 3321—Differential Equations and General Vector Spaces (5)
Phys 1271—General Physics (4)
Phys 1275—General Physics Laboratory (1)
Phys 1281—General Physics (4)
Phys 1285—General Physics Laboratory (1)
Phys 1291—General Physics (4)
Phys 1295—General Physics Laboratory (1)
Rhet 1151—Writing in Your Major (4)
Electives and liberal education requirements

Junior Year—46 required credits

CE 3400—Fluid Mechanics (4)
ForP 3300—Wood Industry Tours (2)
ForP 3301—Industrial Internship (2)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties (3)
ForP 5302—Wood Chemistry I (3)
ForP 5305—Pulp and Paper Technology (4)
ForP 5310—Pulp and Paper Process Laboratory (3)
ForP 5311—Pulp and Paper Process Engineering Calculations I (4)
ForP 5312—Pulp and Paper Process Engineering Calculations II (4)
ForP 5315—Paper Engineering Laboratory (2)
ForP 5331—Undergraduate Seminar (2)
ForP 5353—Wood Chemistry II (3)
ForP 5361—Adhesion and Adhesives (3)
ME 3301—Thermodynamics (4)

Senior Year—31 required credits

AgEn 5070—Automatic Control and Instrumentation (4)
Chem 5520—Elementary Physical Chemistry (3)
ForP 5306—Analysis of Production Systems (3)
ForP 5313—Pulp and Paper Process Operations (4)
ForP 5316—Coated Product Development (2)
ForP 5359—Surface and Colloid Chemistry of Papermaking (3)

ME 5342—Heat Transfer (4)
Rhet 3562—Writing in Your Profession (4)
Stat 3011—Statistical Analysis (4)

Suggested Electives

CE 5500—Analysis and Design of Water Supply Systems (4)
CE 5501—Analysis and Design of Wastewater Systems (4)
Chem 5521—Elementary Physical Chemistry (3)
ChEn 5001—Computational Methods in Chemical Engineering and Material Science (4)
ChEn 5101—Principles of Chemical Engineering I (4)
ChEn 5102—Principles of Chemical Engineering II (4)
IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
ME 3201—Mechanical Engineering Systems Analysis (4)
ME 3303—Applied Thermodynamics (4)
ME 3701—Basic Measurements Laboratory I (2)
ME 3702—Basic Measurements Laboratory II (2)
ME 5283—Industrial Instrumentation and Automatic Control (4)
Stat 3012—Statistical Analysis (4)

Total Graduation Requirements—192 credits

Required courses listed above (167 credits), liberal education requirements in categories C and D (11 credits), and electives (14 credits).

Wood Science—This specialization is designed for students who want a broad education in forest products coupled with strong training in biology, chemistry, math, and physics. Completion of this specialization is excellent preparation for technical jobs in the wood products industry or for going on to graduate school.

Freshman Year—45 required credits

Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1004—General Principles of Chemistry (5)
Chem 1005—General Principles of Chemistry (5)
Chem 1006—Principles of Solution Chemistry (4)
ForP 1001—Forest Products Orientation (1)
ForP 1104—Library Research Methods (1)
Math 1211—Calculus I (5)
Math 1221—Calculus II (5)
Math 1241—Linear and Nonlinear Multivariable Analysis I (5)
Rhet 1101—Writing to Inform and Persuade (4)
Electives and liberal education requirements

Sophomore Year—46 required credits

Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Laboratory I (2)
Chem 3306—Elementary Organic Chemistry Laboratory II (2)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)
Math 3211—Multivariable Calculus (5)
Phys 1271—General Physics (4)
Phys 1275—General Physics Laboratory (1)
Phys 1281—General Physics (4)
Phys 1285—General Physics Laboratory (1)

Phys 1291—General Physics (4)
 Phys 1295—General Physics Laboratory (1)
 Rhet 1151—Writing in Your Major (4)
 Electives and liberal education requirements

Junior Year—41 required credits

AgEc 1101—Principles of Microeconomics (4)
 AgEc 1102—Principles of Macroeconomics (5)
 Chem 3100—Quantitative Analysis Lecture (3)
 Chem 3101—Quantitative Analysis Laboratory (2)
 Chem 5520—Elementary Physical Chemistry (3)
 ForP 3300—Wood Industry Tours (2)
 ForP 5300—Wood-Fluid Relationships (3)
 ForP 5301—Mechanical Properties (3)
 ForP 5302—Wood Chemistry I (3)
 ForP 5303—Wood Deterioration (3)
 ForP 5331—Undergraduate Seminar (2)
 Rhet 1222—Public Speaking (4)
 Stat 3011—Statistical Analysis (4)
 Electives and liberal education requirements

Senior Year—33 required credits

AgET 3030—Introduction to Problem Solving With Computers (4)
 or CSci 3101—A FORTRAN Introduction to Computer Programming (4)
 ForP 5304—Wood Drying and Preservation Processes (4)
 ForP 5305—Pulp and Paper Technology (4)
 ForP 5306—Analysis of Production Systems (3)
 ForP 5307—Wood-Base Panel Technology (4)
 ForP 5353—Wood Chemistry II (3)
 ForP 5355—Mechanics and Structural Design With Wood Products (4)
 ForP 5361—Adhesion and Adhesives (3)
 Rhet 3562—Writing in Your Profession (4)
 Electives and liberal education requirements

Total Graduation Requirements—192 credits
 Required courses listed above (165 credits), liberal education requirements in categories C and D (11 credits), and electives (16 credits).

Forest Resources

This curriculum prepares students to manage forest lands for timber, wildlife, recreation, water production, and environmental enhancement. Graduates may become directly involved in land management or play specialized supporting roles in areas ranging from nursery management to public relations. Still others find employment in related fields such as environmental education and interpretation.

All students take the *core curriculum* of required courses (including the Itasca and Cloquet sessions) listed by year below. In addition, students must complete a minimum of 20 credits in one of the seven *areas of emphasis* listed below. A student may also submit a proposal for an individual area of

emphasis, including an explanation of its professional relevance and the courses to be completed, to the faculty for their review and approval.

Core Curriculum

Freshman Year—49-50 required credits

Biol 1008—Introductory Biology: An Evolutionary Approach (4)
 or Biol 1009—General Biology (5)
 Biol 1103—General Botany (5)
 Chem 1001—Chemical Principles and Covalent Systems (5)
 or Chem 1004—General Principles of Chemistry (5)
 Chem 1002—Chemical Principles and Covalent Systems (5)
 or Chem 1005—General Principles of Chemistry (5)
 FR 1001—Forest Resources Orientation (1)
 FR 1104—Library Research Methods (1)
 Geo 1001—Introduction to Geology (4)
 and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
 or Geo 1111—Physical Geology (5)
 Math 1008—Trigonometry (4) (students with a C or better in high school trigonometry are exempt)
 Math 1111—College Algebra and Analytic Geometry (5)
 or Math 1201—Pre-Calculus (5)
 Math 1142—Short Calculus (5)
 or Math 1211—Calculus I (5)
 Phys 1001—The Physical World (4)
 Phys 1005—Physics Laboratory (1)
 Rhet 1101—Writing to Inform and Persuade (4)
 Electives and liberal education requirements

Sophomore Year—31-35 required credits

AgEc 1101—Principles of Microeconomics (4)
 AgEc 1102—Principles of Macroeconomics (5)
 FR 3300—Elements of Surveying (2)¹ (offered at the Cloquet Forestry Center)
 or CE 3100—Introduction to Surveying and Mapping (4)²
 CSci 3101—A FORTRAN Introduction to Computer Programming (4)
 or CSci 3102—Introduction to Pascal Programming (4)
 or AgET 3030—Introduction to Problem Solving With Computers (4)
 or GC 1571—Introduction to BASIC Programming and Microcomputers (5)³
 ForP 1301—Wood as a Raw Material (4)
 Rhet 1151—Writing in Your Major (4)
 Rhet 1222—Public Speaking (4)
 Stat 3011—Statistical Analysis (4)
 or Stat 5021—Statistical Analysis (5)
 Electives and liberal education requirements

Itasca Session—6 required credits

This summer term is to be taken between the freshman and sophomore or sophomore and junior years.

¹FR 3300 may be taken as part of the Cloquet Session.

²Students need override from the Civil Engineering Department to register.

³Students who wish to take FR 5110 should not take GC 1571.

Baccalaureate Programs

FR 3100—Minnesota Plants (2)
FR 3101—Field Forest Ecology (3)
FR 3201—Field Forest Measurements (1)
Junior Year—33 required credits
FR 1100—Dendrology (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)

FR 3104—Forest Ecology (3)
FR 3232—Management of Recreational Lands (3)
FR 5100—Silviculture (3)
FR 5114—Forest Hydrology (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (3)
FR 5215—Forest Fire Management (2)
FW 3052—Introduction to Fisheries and Wildlife (3)
Soil 1020—The Soil Resource (4)
Electives and liberal education requirements

Senior Year—30 required credits

Fall Quarter—Cloquet Session
FR 5101—Field Silviculture (4)
FR 5115—Forest Hydrology, Field Applications (2)
FR 5126—Silviculture: Soil-Site Relationships (2)
FR 5220—Remote Sensing, Forest Resources Inventory (4)
FR 5236—Forest Recreation Planning (1)
FR 5248—Harvesting and Engineering (3)
FW 3167—Techniques of Forest Wildlife Management (2)

Winter and Spring Quarters—on campus
FR 5226—Forest Economics and Planning (5)
FR 5240—Natural Resource Policy and Administration (3)

Rhet 3562—Writing in Your Profession (4)
Electives and liberal education requirements

Total Graduation Requirements—192 credits
Required courses listed above (149-154 credits), liberal education requirements in categories C and D (11 credits), and electives and credits to satisfy area of emphasis (27-32 credits).

Areas of Emphasis

Forest Hydrology—This interdisciplinary emphasis helps develop skills to solve water resource problems. Students will qualify as hydrologists on the Civil Service register, and also meet the qualifying criteria for forest and range hydrologists as established by the Association of University Watershed Scientists. For more information, contact Dr. Kenneth N. Brooks, 235 Natural Resources Administration Building, (612/624-2774) or Dr. James A. Perry, Green Hall (612/624-9796).

Required Courses—26 credits
Math 1211, 1221—Calculus I, II (10)
FR 5153—Advanced Forest Hydrology (4)
CE 5401—Water Resources Engineering (4)
CE 5405—Hydrology and Hydrologic Design (4)
FR 5458—Water Quality Management: Ecosystem Approaches (4)

Recommended Electives—at least four related courses; the list below is not all-inclusive.
FR 5231—Range Management (3)
FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5264—Quantitative Techniques in Forest Management (3)
AgEn 5540—Erosion Control, Watershed Engineering (4)
CE 3400—Fluid Mechanics (4)
CE 5402—Computational Hydraulics (4)
CE 5410—Open Channel Hydraulics (4)
CE 5425—Groundwater Mechanics (4)
CE 5501—Analysis and Design of Wastewater Systems (4)
CE 5505—Water Quality Engineering (4)
CE 5506—Environmental Water Chemistry (4)
CE 5420—Introduction to Water Resources Management (4)
Geo 5251—Geomorphology (4-5)
Geo 5611—Groundwater Geology (4)
Soil 5232—Soil Physics (5)
Soil 5310—Soil Chemistry (4)
Soil 5240—Microclimatology (4)
Soil 5710—Advanced Forest Soils (3-4)

Forest Soils—This emphasis covers forest soil science, land use, management planning, and forest production. Students will qualify as soil scientists on the Civil Service register as well as satisfy requirements for a soil science minor (which can be entered directly on the transcript). For more information, contact Dr. David F. Grigal, 556 Borlaug Hall (612/625-4232).

Required Courses—23-25 credits
Soil 1020—The Soil Resource (4) or Soil 3125—Basic Soil Science (4)
Soil 3416—Soil Fertility (5)
Soil 3520—Soil Morphology, Classification, and Genesis (4)
Soil 5710—Advanced Forest Soils (3-4)
Soil 3225—Physical Soil Management and Conservation (4)
Soil elective (3-4)

Recommended Electives—at least two courses (including 3 cr in Soil Science)
Ent 5250—Forest Entomology (4)
FR 3104—Forest Ecology (3)
FR 5120—Introductory Tree Physiology and Genetics (4)
FR 5153—Advanced Forest Hydrology (4)
FR 5231—Range Management (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5264—Quantitative Techniques in Forest Management (3)
Geo 5251—Geomorphology (4-5)
Geo 5261—Glacial Geology (4-5)
Soil 5610—Soil Biology (4)
Soil 3118—Seminars on Special Topics (1 each)
Soil 5230—Soil-Plant Water Relations (3)
Soil 5232—Soil Physics (5)
Soil 5240—Microclimatology (4)
Soil 5515—Soil Development, Classification, and Geography (4)

Soil 5550—Peatlands: Formation, Classification, and Utilization (3)

Soil 5560—Soil Survey Interpretations (3)

PIPa 5050—Forest Pathology (4)

Management and Administration—

This emphasis is for students interested in administrative careers in public resource agencies or forest industries. Concepts and techniques used to develop policies and programs and to manage people and processes in large organizations are explored, providing a framework for systematic individual development through experience and continuing education. For more information, contact Dr. Paul V. Ellefson, 330B Green Hall (612/624-3735); Dr. Hans M. Gregersen, 301D Green Hall (612/624-6298); or Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711).

Required Courses—10 credits

- Mgmt 3001—Fundamentals of Management (4)
- Act 1024—Principles of Financial Accounting I (3)
- FR 5241—Natural Resource Management: Political and Administrative Processes (3)
- or FR 5264—Quantitative Techniques in Forest Management (3)

Recommended Electives—37-38 credits

- Acct 1025—Principles of Financial Accounting II (3)
- Acct 3001—Managerial Accounting (4)
- BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
- or PA 5102—Legal Environment of Public Affairs (3)
- BGS 3002—Business and Society (4)
- IR 3010—Human Relations and Applied Organization Theory (4)
- Mgmt 3000—Finance Fundamentals (4)
- Mgmt 3002—Psychology in Management (4)
- MIS 3300—Introduction to Computers and Management Information Systems (4)
- or AgEc 3300—Agricultural Management Information Systems (4)
- PA 5200—Introduction to Planning (3)
- Pol 3307—The American Bureaucracy (4)

Industrial Forest Management—

This emphasis is for students who wish to gain a more complete understanding of industrial forest management. Planning, decision-making, and project implementation activities are emphasized. For more information, contact Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711).

Required Courses—28-29 credits

- FP 3303—Forest Products Marketing (3)
- FP 3300—Wood Industry Tours (2)
- or FP 5306—Analysis of Production Systems (3)
- FR 5241—Natural Resource Management: Political and Administrative Processes (3)

FR 5253—Forest Biometry (3) (*offered alt even years*)
or FR 5255—Forest Resource Survey Design (3)
(*offered alt odd years*)

FR 5264—Quantitative Techniques in Forest Management (3)

IEOR 5050—Engineering Economics Analysis (4)

Math 1221—Calculus II (5)¹

Math 1241—Linear and Nonlinear Multivariable Analysis I (5)

Recommended Electives

- IEOR 3000—Introduction to Industrial Engineering Analysis (4)
- IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
- IEOR 5040—Introduction to Operations Research (4)
- IEOR 5441—Operations Research II (4)
- MIS 3300—Introduction to Computers and Management Information Systems (4)
- or AgEc 3300—Agricultural Management Information Systems (4)
- CSci 3101—A FORTRAN Introduction to Computer Programming (4)
- Stat 5021—Statistical Analysis (5)
- Stat 5301—Designing Experiments (5)
- Stat 5302—Applied Regression Analysis (5)

Resource Measurements and Information Systems—

This emphasis is for students with analytical skills interested in forest measurement and information systems. Focus is on such subjects as sampling, mathematical modelling, statistics, computer science, remote sensing, and decision support systems. For more information, contact Dr. Alan R. Ek, 115C Green Hall (612/624-3098); Dr. Thomas E. Burk, 35A Natural Resources Administration Building (612/624-6741); or Dr. Sean C. Ahearn, 220F Green Hall (612/624-6709).

Required Courses—22 credits

- FR 5253—Forest Biometry (3) (*offered alt even yrs*)
or FR 5255—Forest Resource Survey Design (3)
(*offered alt odd yrs*)
- Stat 5021—Statistical Analysis (5)
- Math 1221—Calculus II (5)
- Math 1241—Linear and Nonlinear Multivariable Analysis I (5)
- CSci 3101—A FORTRAN Introduction to Computer Programming (4)
- or CSci 3102—Introduction to Pascal Programming (4)
- or other FORTRAN or Pascal (4)
- Recommended Electives—**at least two courses
- FR 5264—Quantitative Techniques in Forest Management (3)
- or IEOR 5040—Introduction to Operations Research (4)
- FR 5262—Remote Sensing of Natural Resources (4)
- Stat 5302—Applied Regression Analysis (5)
- Stat 5301—Designing Experiments (5)

¹Students should take Math 1201 and 1211 (which count toward the 36 credits required for operations research analysts) in their freshman year.

Baccalaureate Programs

Forest Harvesting—This emphasis is for students interested in timber harvesting and its impact on other land management considerations. The coursework is interdisciplinary and requires careful preparation for spending the senior year at the University of Idaho earning 14 semester credits (21 quarter credits). Students are trained for careers in logging engineering firms, forest products companies, and government agencies. Typical work includes planning and designing timber sales, supervising logging crews, designing and laying out roads, and managing wood procurement. For more information, contact Dr. A. Scott Reed, Cloquet Forestry Center, Cloquet, MN 55720 (218/879-4528).

Junior Year

Fall Quarter (Minnesota)—10-12 credits

FR 3103—Meteorology and Climatology for Natural Resource Managers (2)

FR 3104—Forest Ecology (3)

FW 3052—Introduction to Fisheries and Wildlife (3)

CE 3100—Introduction to Surveying and Mapping (4)¹

or FR 3300—Elements of Surveying (2) (offered at the Cloquet Forestry Center)

Winter Quarter (Minnesota)—13 credits

Rhet 3562—Writing in Your Profession (4)

FR 5100—Silviculture (3)

FR 5200—Aerial Photo Interpretation (3)

FR 5240—Natural Resource Policy and Administration (3)

Spring Quarter (Minnesota)—13 credits

FR 5212—Natural Resources Inventory (3)

FR 5215—Forest Fire Management (2)

FR 5226—Forest Economics and Planning (5)

FR 5231—Range Management (3)

Senior Year

Fall Quarter (Cloquet)—18 credits

Spring Semester (Idaho)—6 semester credits

For Pr 431—Production and Cost Control in Timber Harvesting (3 sem/4.5 qtr cr)

For Pr 433—Forest Tractor Systems Analysis (3 sem/4.5 qtr cr)

Electives

Fall Semester (Idaho)—8 semester credits

For Pr 434—Cable Systems Analysis (3 sem/4.5 qtr cr)

For Pr 432—Low Volume Forest Roads (3 sem/4.5 qtr cr)

For 462—Watershed Management (2 sem/3 qtr cr)

Recommended Electives (Idaho)

Bus 370—Industrial Management (3 sem/4.5 qtr cr)

CE 482—Project Management Techniques (1.4 sem/1.5-6 qtr cr)

CE 486—Engineering Economics (3 sem/4.5 qtr cr)

For Pr 335—Primary Wood Products Processes (3 sem/4.5 qtr cr)

For Pr 477—Topics in Forest Industries Management (3 sem/4.5 qtr cr)

For Pr 522—Advanced Forest Roads (3 sem/4.5 qtr cr)

For Pr 534—Advanced Techniques of Timber

Harvesting (3 sem/4.5 qtr cr)

For 470—Introduction to Forest Resources Planning (2 sem/3 qtr cr)

For 476—Forest Investment Analysis (2 sem/3 qtr cr)

For 477—Forest Harvest Scheduling (2 sem/3 qtr cr)

For 575—Advanced Forest Management (2 sem/3 qtr cr)

Recommended Electives (Minnesota)

FR 5140—Application of Silviculture in North American Forest Types (3)

Soil 5710—Advanced Forest Soils (3-4)

FR 5153—Advanced Forest Hydrology (4)

Silviculture/Forest Biology—This emphasis is for students interested in the biological sciences such as ecology, silviculture, and physiology. It provides background information for careers as forest resource managers and silviculturist specialists. For more information, contact Dr. Alvin A. Alm, Cloquet Forestry Center, Cloquet, MN 55720 (218/879-4528) or Dr. Edward Sucoff, 103 Green Hall (612/624-7249).

For the following required and recommended courses, course numbers followed by "u" are offered winter quarter and those followed by "s" are offered spring quarter.

Required Courses—15-16 credits

Ent 5250s—Forest Entomology (4)

FR 5120w—Introductory Tree Physiology and Genetics (4)

Soil 5710s—Advanced Forest Soils (3-4)

PIPa 5050s—Forest Pathology (4)

Recommended Electives—12 credits minimum; at

least three courses from the following list of FR courses; in addition, any 5000-level course in Soils, Plant Biology, or a related course may be used.

FR 5106w—Senior Silviculture Seminar (2-3)

FR 5110w—Forestry Applications of Microcomputers (4)

FR 5140s—Application of Silviculture in North

American Forest Types (3)

FR 5152w—Forest Genetics (3)

FR 5231s—Range Management (3)

FR 5262w—Remote Sensing of Natural Resources (4)

FR 5700—Colloquium in Forest Biology (1-2)

FR 5121w—Tree Physiology Laboratory (1)

Forest Resources Minor

This minor helps students in natural resources or related areas to develop a solid understanding of forest resource dynamics, management, and the importance of forest resources in our society. The minor incorporates a fundamental science background plus coursework

¹Students need override from the Civil Engineering Department to register.

dealing with the multiple uses and manipulation of forest resources and their assessment and policy implications. Open to students who have completed the required background courses or the equivalent, the minor is awarded once the minor core and optional courses are completed.

Minor Core—13-14 credits

- FR 1100—Dendrology (4)
- FR 1200—Introduction to Forest Resources (3)
 - or FR 1201—Conservation of Natural Resources (3)
 - or FR 1202—Farm and Small Woodlands Forestry (3)
 - or FR 1203—Introduction to Minnesota's Natural Resources (3)
 - or FR 5406—Forestry Workshop for Teachers (3)
- FR 3104—Forest Ecology (3)¹
 - or Biol 5041—Ecology (4)
- FR 5100—Silviculture (3)

Optional Courses—7 credits, with at least one course from each of these two categories:

Management and Policy

- ForP 1301—Wood as a Raw Material (4)
- FR 3102—Southern Forest Resource Tour (1)
- FR 3232—Management of Recreational Lands (3)
- FR 3250 or 5250—Role of Renewable Natural Resources in Developing Countries (2)
- FR 5200—Aerial Photo Interpretation (3)
- FR 5212—Natural Resources Inventory (3)
- FR 5220—Remote Sensing, Forest Resources Inventory (4) (*Cloquet*)
- FR 5226—Forest Economics and Planning (5)
- FR 5231—Range Management (3)
- FR 5233—Principles of Outdoor Recreation Design and Planning (4)
- FR 5236—Forest Recreation Planning (1) (*Cloquet*)
- FR 5240—Natural Resource Policy and Administration (3)
- FR 5241—Natural Resource Management: Political and Administrative Processes (3)
- FR 5248—Harvesting and Engineering (3) (*Cloquet*)
- FR 5253—Forest Biometry (3)
- FR 5255—Forest Resource Survey Design (3)
- FR 5257—Recreation Land Policy (3)
- FR 5259—Analysis of Outdoor Recreation Behavior (3)
- FR 5262—Remote Sensing of Natural Resources (4)
- FR 5264—Quantitative Techniques in Forest Management (3)
- FR 5500—Urban Forest Management (3)
 - or FR 5408—Forestry in the Urban Environment (3)

Biology

- Ent 5250—Forest Entomology (4)
- FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
- FR 5101—Field Silviculture (4) (*Cloquet*)
- FR 5114—Forest Hydrology (3)
- FR 5115—Forest Hydrology, Field Applications (2) (*Cloquet*)
- FR 5120—Introductory Tree Physiology and Genetics (4)
- FR 5121—Tree Physiology Laboratory (1)
- FR 5126—Silviculture: Soil-Site Relationships (2) (*Cloquet*)

- FR 5140—Application of Silviculture in North American Forest Types (3)
- FR 5152—Forest Genetics (3)
- FR 5153—Advanced Forest Hydrology (4)
- FR 5215—Forest Fire Management (2)
- FR 5217—Field Techniques for Prescribed Burning (1)
- FR 5218—Field Techniques for Forest Fire Control (1)
- FR 5458—Water Quality Management: Ecosystem Approaches (4)
- PlPa 5050—Forest Pathology (4)
- Soil 1020—The Soil Resource (4)

Natural Resources and Environmental Studies

The Natural Resources and Environmental Studies curriculum, jointly offered with the College of Agriculture, is for students interested in an interdisciplinary education focusing on the use and management of natural resources and the study of the environment.

Students have considerable flexibility in designing their study program.

Programs can be designed to achieve one or more of the following objectives:

- Gain an understanding of the interaction between natural resources and modern society. Learn about the significant social and environmental roles that natural resources can play nationally and internationally.
- Prepare for careers in public and private organizations that are responsible for planning the use and management of natural resources and protection of the environment. Learn about subjects that will prepare you for positions in fields such as environmental assessment, resource inventory, natural resource planning, environmental protection, sustainable development, policy analysis, and natural resource management.
- Develop appropriate background for graduate study.

All students take the core curriculum of required courses (including two colloquia) listed below. In addition, students must complete a minimum of 24 credits in one of the five areas of concentration.

¹This requirement can also be met by the following courses offered at Itasca: FR 3100—Minnesota Plants (2), FR 3101—Field Forest Ecology (3), FR 3201—Field Forest Measurements (1).

Baccalaureate Programs

Core Curriculum

Freshman and Sophomore Years—84-90 credits

A. Communication, Language, and Symbolic Systems—22 credits

- Rhet 1101—Writing to Inform and Persuade (4)
FR or FW or ForP 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Math 1142—Short Calculus (5)
Stat 3011—Statistical Analysis (4)

B. Physical, Biological, and Analytical Sciences—32-38 credits

- Biol 1009—General Biology (5)
Biol 1103—Botany (5) or Biol 1106—Zoology (5)
Chem 1004, 1005—General Principles of Chemistry (5,5)
or Chem 1001, 1002—Chemical Principles and Covalent Systems (5,5)
or Chem 1003—Physical World Chemistry (5)
Phys 1041-1045—Introductory Physics and Laboratory (4,1)
or Phys 1001, 1005—The Physical World (4, 1)
Geo 1001—Introduction to Geology (4)
or Geo 1111—Introductory Physical Geology (5)
NRES 1001—Orientation to Natural Resources and Environmental Studies (1)
NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)¹
FR 1201—Conservation of Natural Resources (3)
FR 3250—Role of Renewable Natural Resources in Developing Countries (2)
or NRES 1040—Natural Resources as Raw Materials (2)
or NRES 1010—Issues in the Environment (3)

C. The Individual and Society—22 credits

Required Courses—14 credits

- AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (5)
Pol 1001—Political Science (5)

Suggested Courses—8 credits:

- Pol 3307—The American Bureaucracy (4)
Soc 1001—Introduction to Sociology (4)
Soc 1002—The American Community (4)
HSci 1711—Technology and Western Civilization (4)
Anth 5117—Anthropology of Resource Management (4)

D. Literature, Humanities, and Fine Arts—8 credits

Suggested courses:

- Hum 1005—Humanities in the Modern World (4)
Rhet 1301—Modern Thought and the Enlightenment (4)
Rhet 1302—Modern Thought and the Industrial Revolution (4)
Rhet 1303—Modern Thought and the Impact of Evolution (4)
Rhet 1310—Humanities: The Land in American Experience (4)

Junior and Senior Years—90-96 credits

Required Courses—41-50 credits

- NRES 3050—Experience and Training in a Field Setting (1-4)
NRES 3099—Problem Solving in Natural Resources I (1)
NRES 3100—Problem Solving in Natural Resources II (3)

- Soil 1020—The Soil Resource (4)
or Soil 3125—Basic Soil Science (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
or Soil 1262—Introduction to Meteorology (4)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
FR 5114—Forest Hydrology (3)
or AgEt 5410—Hydrology and Water Quality (5)
FR 5212—Natural Resources Inventory (3)
FR 5240—Natural Resource Policy and Administration (3)
FR 5226—Forest Economics and Planning (5)
or AgEc 3610—Community Resource Development (4)
Rhet 3562—Writing in your Profession (4)
Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)
or Soil 3225—Physical Soil Management and Conservation (4)
or AgEc 3040—Economic Development of American Agriculture (4)
FR 5100—Silviculture (3)
or FR 5241—Natural Resources Management: Political and Administrative Processes (3)
FW 3052—Introduction to Fisheries and Wildlife (3)

Total Graduation Requirements—180 credits

Required courses listed above (95-110), liberal education requirements in categories C and D (30 credits), and electives and credits in area of concentration (40-55 credits).

Areas of Concentration—24 credits

Resource Assessment—Focus on development of skills for assessing the magnitude and quality of various natural and environmental resources with techniques such as remote sensing, quantitative analysis, and geographic information systems. For more information, contact Dr. Marvin E. Bauer, 220B Green Hall (612/624-3703); Dr. Sean C. Ahearn, 220F Green Hall (612/624-6709); Dr. Melvin J. Baughman, 330G Green Hall (612/624-0734); Dr. Alan R. Ek, 115C Green Hall (612/624-3400); Dr. Lloyd P. Queen, 220C Green Hall (612/623-9271); Dr. David W. Lime, 301G Green Hall (612/224-2250); or Dr. Thomas E. Burk, 35A Natural Resources Administration Building (612/624-6741).

- AgEc 3040—Economic Development of American Agriculture (4)
AgEc 3610—Resource Development and Environmental Economics (4)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
EBB 5613—Assessing the Ecological Effects of Pollution (4)

¹Students must complete two colloquia.

Natural Resources and Environmental Studies

- Econ 5611—Pollution Control and Research Economics (4)
FR 3232—Management of Recreational Lands (3)
FR 3300—Elements of Surveying (2)
FR 5100—Silviculture (3)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (3)
FR 5231—Range Management (3)
FR 5233—Principles of Outdoor Recreational Design (4)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5412—Advanced Remote Sensing (4)
FR 5458—Water Quality Management (4)
FW 5603—Wildlife Habitat Relationships and Management (4)
Geog 5562—Introduction to Geographic Information Systems (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
Soil 5232—Soil Physics (5)
Soil 5550—Peatlands (3)

Water Resources—Focus on the management of water resources to achieve desired water quantity and quality. Special emphasis on water movement, storage, and hydrologic and climatologic cycles. (Students should take Math 1211 and 1221 in place of Math 1142.) For more information, contact Dr. Kenneth N. Brooks, 235E Natural Resources Administration Building (612/624-2774); or Dr. James A. Perry, 312 Green Hall (612/624-9796).

- AgEn 5540—Erosion Control (4)
AgEn 5550—Drainage and Irrigation Engineering (6)
AgET 5410—Hydrology and Water Quality (5)
CE 3400—Fluid Mechanics (4)
CE 5401—Water Resources Engineering (4)
CE 5505—Water Quality Engineering (4)
CE 5510—Solid and Hazardous Waste Management (4)
CE 5515—Water and Waste Microbiology (4)
CE 5580—Environmental Law (3)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 5100—Silviculture (3)
FR 5114—Forest Hydrology (3)
FR 5115—Forest Hydrology, Field Applications (2) (offered at the Cloquet Forestry Center)
FR 5153—Advanced Forest Hydrology (4)
FR 5458—Water Quality Management (4)
Geo 5601—Limnology (4)
Geo 5611—Groundwater Geology (4)
Geog 5444—Geography of Water (4)
PubH 5242—Environmental Aspects of Ground Water (2)
Soil 3416—Soil Fertility (5)
Soil 5240—Microclimatology (4)

Resources and Environmental

Protection—Focus on understanding major environmental protection issues and their solutions. Topical concerns include solid waste management, global climate change, and protection of plant and animal resources. For more information, contact Dr. Edward Sucoff, 103 Green Hall (612/624-7249); Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711); Dr. Hans M. Gregersen, 301D Green Hall (612/624-4-6298); Dr. James A. Perry, 312 Green Hall (612/624-9796); Dr. Carl Mohn, 105 Green Hall (623/624-7281); Dr. Ira R. Adelman, 200 Hodson Hall (612/624-3600); or Dr. James R. Kitts, 216 Hodson Hall (612/624-3298).

- AgEc 5600—Land Economics (4)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
EBB 5613—Assessing the Ecological Effects of Pollution (4)
Econ 5611—Pollution Control and Research Economics (4)
FR 5100—Silviculture (3)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5458—Water Quality Management (4)
Geo 5108—Advanced Environmental Geology (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
PA 5102—Legal Environment of Public Affairs (3)
PA 5721—Environmental Policy (3)
Pol 5523—Politics of the Regulatory Process (4)
PubH 5181—Air Pollution (3)
PubH 5242—Environmental Aspects of Ground Water (2)
PubH 5253—Hazardous Waste Management (3)
Soil 3225—Physical Soil Management and Conservation (4)
Soil 3416—Soil Fertility (5)
Soil 5340—Organic and Pesticidal Residues (5)

Environmental Issues and

Planning—Focus on major issues in natural resources and the environment at local, national, and worldwide levels. Special emphasis on understanding, analysis, planning, and decision making required to address these problems. For more information, contact Dr. James L. Bowyer, 290 Kaufert Lab (612/624-4292); Dr. Paul V. Ellefson, 330B Green Hall (612/624-3735); Dr. Thomas E. Burk, 35A Natural Resources Administration Building (612/624-6741); Dr. Howard M. Hoganson, North Central

Baccalaureate Programs

Experiment Station, Grand Rapids, MN 55744 (218/327-4490); Dr. Francesca J. Cuthbert, 320 Hodson Hall (612/624-1756); Dr. David W. Lime, 301G Green Hall (612/624-2250); Dr. Melvin J. Baughman, 330G Green Hall (612/624-0734); Dr. Alvin Alm, Cloquet Forestry Center (218/897-4528); or Dr. Peter A. Jordan, 142 Hodson Hall (612/624-9281).

- AgEc 3040—Economic Development of American Agriculture (4)
AgEc 3610—Resource Development and Environmental Economics (4)
AgEc 5650—Economics of Natural Resources (4)
Anth 5117—Energy Research Use (4)
CE 5580—Environmental Law (3)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
EBB 5613—Assessing the Ecological Effects of Pollution (4)
Econ 5611—Pollution Control and Research Economics (4)
FR 3232—Management of Recreational Lands (3)
FR 5100—Silviculture (3)
FR 5226—Forest Economics and Planning (5)
FR 5233—Principles of Outdoor Recreational Design (4)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5257—Recreational Land Policy (3)
FW 5603—Wildlife Habitat Relationships and Management (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
PA 5001—Policy Process (3)
PA 5102—Legal Environment of Public Affairs (3)
PA 5721—Environmental Policy (3)
Pol 5523—Politics of the Regulatory Process (4)

Soil Resources—Focus on management, interpretation, and inventory of soil resources. Emphasis on preventing soil erosion and reducing land degradation and adverse impacts of erosion on water and air quality. For more information, contact Dr. David F. Grigal, 439 Borlaug Hall (612/625-4232).

- AgEc 5600—Land Economics (4)
AgET 5410—Hydrology and Water Quality (5)
FR 3104—Forest Ecology (3)
or EBB 3001—Introduction to Ecology (4)
FR 5100—Silviculture (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5231—Range Management (3)
Soil 3225—Physical Soil Management and Conservation (4)
Soil 3416—Soil Fertility (5)
Soil 3520—Soil Morphology, Classification, and Genesis (4)
Soil 5232—Soil Physics (5)
Soil 5240—Microclimatology (3)
Soil 5340—Organic and Pesticidal Residues (5)
Soil 5550—Peatlands (3)
Soil 5610—Soil Biology (4)
Soil 5710—Advanced Forest Soils (3)

Recreation Resource Management

The objectives of this curriculum are to prepare students for careers in the comprehensive planning and management of land and water for recreation, with emphasis on natural non-urban areas; for participation in government resource-oriented recreation programs as well as private planning and consulting; and for graduate work in resource planning and management. The traditional core courses usually required for federal forester positions are listed under the Federal Forestry option.

Required Courses

- Freshman Year**—51-52 required credits
Biol 1008—Introductory Biology: An Evolutionary Approach (4)
or Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1001—Chemical Principles and Covalent Systems (5)
or Chem 1004—General Principles of Chemistry (5)
Chem 1002—Chemical Principles and Covalent Systems (5)
or Chem 1005—General Principles of Chemistry (5)
FR 1001—Forest Resources Orientation (1)
FR 1104—Library Research Methods (1)
FR 1201—Conservation of Natural Resources (3)
Geo 1001—Introduction to Geology (4)
and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
or Geo 1111—Physical Geology (5)
Geog 1401—Physical Geography (5)
or Geog 1301—Human Geography (5)
Math 1008—Trigonometry (4) (students with a C or better in high school trigonometry are exempt)
Math 1111—College Algebra and Analytic Geometry (5)
or Math 1131—Finite Mathematics (5)
or Math 1201—Pre-Calculus (5)
Rhet 1101—Writing to Inform and Persuade (4)
Soils 1020—The Soil Resource (4)
or Soils 3125—Basic Soil Science (4)
Electives and liberal education requirements
Sophomore Year—45-48 required credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (5)
Biol 5041—Ecology (4)
FR 1100—Dendrology (4)
LA 1024—Landscape Theory (4)
or LA 1031—Introduction to Landscape Architecture (4)
or LA 1001—Landscape Architecture: The Design of Environments (2)
Math 1142—Short Calculus (5)
or Math 1211—Calculus I (5)

- Phys 1001—The Physical World (4)
and Phys 1005—Physics Laboratory (1) (students who have completed high school physics with a B or better may be exempt, but must first see their adviser)
- Pol 1041—Contemporary Political Ideologies (4)
or Pol 3321—Issues in American Public Policy (4)
or Pol 1001—American Government and Politics (5)

- Psy 1001—Introduction to Psychology (5)
 Rhet 1151—Writing in Your Major (4)
 Rhet 1222—Public Speaking (4)
 Soc 1001—Introduction to Sociology (4)
 Electives and liberal education requirements

Junior Year—31-36 required credits

- AgEc 3610—Community Resource Development (4)
or AgEc 5620—Regional Economic Analysis (3-4)
- FR 5114—Forest Hydrology (3)
 FR 3232—Management of Recreational Lands (3)
 FW 3052—Introduction to Fisheries and Wildlife (3)
 FR 3300—Elements of Surveying (2) (*offered at the Cloquet Forestry Center*)
or Geog 3511—Introduction to Cartography (5)
- Rec 3550—Park and Recreation Administration (5)
or Rec 3530—Recreation and Park Areas and Facilities (5)
- Rhet 3254—Advanced Public Speaking (4)
or Rhet 3266—Communication, Discussion, in Small Group Decision-Making (4)
- Rhet 3562—Writing in Your Profession (4)
- Stat 3011—Statistical Analysis (4)
or Stat 5021—Statistical Analysis (5)
or Soc 3801—Sociological Methods I: Descriptive Statistics (5)
- Electives and liberal education requirements

Senior Year—27 required credits

- EBB 5014—Ecology of Plant Communities (5)
or EBB 5016—Ecological Plant Geography (5)
- FR 5200—Aerial Photo Interpretation (3)
 FR 5233—Principles of Outdoor Recreation Design and Planning (4)
 FR 5259—Analysis of Outdoor Recreation Behavior (3)
or FR 5257—Recreation Land Policy (3)
- FR 5269—Interdisciplinary Seminar I (4)¹
 FR 5270—Interdisciplinary Seminar II (4)¹
- Soc 5401—Social Organization (4)
or Soc 5661—Rural Community Analysis (4)
or Jour 5501—Communication and Public Opinion I (4)
- Liberal education requirements

Recommended Electives

- FR 5110—Forestry Applications of Microcomputers (4)
or other computer course
- FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
- Hort 1021—Woody Plant Materials (5)
or Hort 1022—Herbaceous Plant Materials (5)
- PBio 1009—Minnesota Plant Life (4)
- Rhet 5170—Managerial Communications (4)
- AgEc 1250—Principles of Accounting (5)²
 AgET 3030—Introduction to Problem Solving with Computers (4)
or CSci 3104—Introduction to Programming and Problem Solving (5)
or CSci 3101—A FORTRAN Introduction to Pascal Programming (4)
or GC 1571—Introduction to BASIC Programming and Microcomputers (5)³

- BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)²
- Mgmt 3001—Fundamentals of Management (4)²
 Mgmt 3002—Psychology in Management (4)
- Pol 1001—American Government and Politics (5)
- Rec 5250—Financing Leisure Services (3)²
 Soc 1651—Rural Sociology (4)
 FR 5231—Range Management (3)²

Total Graduation Requirements—192 credits
 Required courses listed above (154-163 credits), liberal education requirements (8 credits in category D), and electives (21-30 credits).

Options

In addition to the required courses listed by year above, students may elect one of the following options (with the consent of their adviser and the Recreation Resource Management faculty).

Federal Forestry (minimum Civil Service qualifications)

- FR 3100—Minnesota Plants (2) (Itasca)
 FR 3101—Field Forest Ecology (3) (Itasca)
 FR 3201—Field Forest Measurements (1) (Itasca)
 FR 5212—Natural Resources Inventory (3)
 FR 5226—Forest Economics and Planning (5)
 PIPa 5050—Forest Pathology (4)
 FR 5114—Forest Hydrology (3)
 FR 5215—Forest Fire Management (2)

Recreation Site Management

- Approved internship proposal (8)
or FR 5269, 5270 (4,4)
 FR 5257—Recreation Land Policy (3)
 FR 5259—Analysis of Outdoor Recreation Behavior (3)
 Soc 5161—Criminal Law in American Society (4)
 Footnoted recommended electives under Senior Year above (23)

Urban Forestry

Urban Forestry involves planning and managing vegetation and associated natural resources in and near urban communities—along streets and in parks, greenbelts, and open spaces. Urban foresters help communities plan and design their urban forests, supervise tree selection and planting, design insect and disease protection programs, and provide related services. City governments are the principal employers, as well as state and federal forestry agencies, forestry consulting firms, tree service firms, and

¹An approved internship may be substituted for the seminar in the Recreation Site Management option.

²Required for Recreation Site Management option.

³Students who wish to take FR 5110 should not take GC 1571.

Baccalaureate Programs

utility companies. Graduates are also qualified for traditional professional forestry positions, including those in the federal government.

Freshman Year—39 required credits

- Biol 1009—General Biology (5)
 - Biol 1103—General Botany (5)
 - FR 1001—Forest Resources Orientation (1)
 - FR 1104—Library Research Methods (1)
 - Math 1008—Trigonometry (4) (Students with a C or better in high school trigonometry are exempt)
 - Math 1111—College Algebra and Analytic Geometry (5)
 - Math 1142—Short Calculus (5)
 - Phys 1001—The Physical World (4)
 - Phys 1005—Physics Laboratory (1)
 - Rhet 1101—Writing to Inform and Persuade (4)
 - Rhet 1222—Public Speaking (4)
- Electives and liberal education requirements

Sophomore year—41-43 required credits

- AgEc 1102—Principles of Macroeconomics (5)
 - AgEc 1250—Principles of Accounting (5)
 - AgET 3030—Introduction to Problem Solving With Computers (4)
 - or CSci 3101—A FORTRAN Introduction to Computer Programming (4)
 - or CSci 3102—Introduction to Pascal Programming (4)
 - or GC 1571—Introduction to BASIC Programming and Microcomputers (5)¹
 - Chem 1001—Chemical Principles and Covalent Systems (5)
 - or Chem 1004—General Principles of Chemistry (5)
 - Chem 1002—Chemical Principles and Covalent Systems (5)
 - or Chem 1005—General Principles of Chemistry (5)
 - Soils 1020—The Soil Resource (4)
 - or Soils 3125—Basic Soil Science (4)
 - Hort 1021—Woody Plant Materials (5)
 - Rhet 1151—Writing in Your Major (4)
 - Stat 3011—Statistical Analysis (4)
 - or Stat 5021—Statistical Analysis (5)
- Electives and liberal education requirements

Itasca Session—6 required credits

This summer term is to be taken between the freshman and sophomore or sophomore and junior years.

- FR 3100—Minnesota Plants (2)
- FR 3101—Field Forest Ecology (3)
- FR 3201—Field Forest Measurements (1)

Junior Year—33 required credits and recommended electives

- ForP 1301—Wood as a Raw Material (4)
- FR 1100—Dendrology (4)
- FR 3104—Forest Ecology (3)
- FR 5100—Silviculture (3)
- FR 5120—Introductory Tree Physiology and Genetics (4)
- FR 5212—Natural Resources Inventory (3)
- FR 5233—Principles of Outdoor Recreation Design and Planning (4)
 - or Hort 3030—Landscape Design of Residential and Small Commercial Sites (4)

- PIPa 5050—Forest Pathology (4)
 - Rhet 3562—Writing in Your Profession (4)
- Electives and liberal education requirements

Senior Year—28 required credits and recommended electives

- Ent 5250—Forest Entomology (4)
 - FR 5200—Aerial Photo Interpretation (3)
 - FR 5226—Forest Economics and Planning (5)
 - FR 5240—Natural Resource Policy and Administration (3)
 - or FR 5501—Urban Forest Administration (3)
 - FR 5500—Urban Forest Management (3)
 - Hort 5046—Nursery Management and Production I (4)
 - Hort 5047—Nursery Scheduling and Enterprise Development (2)
 - Hort 5048—Nursery Management and Production II (4)
- Liberal education requirements

Recommended Electives (at least 19 credits)

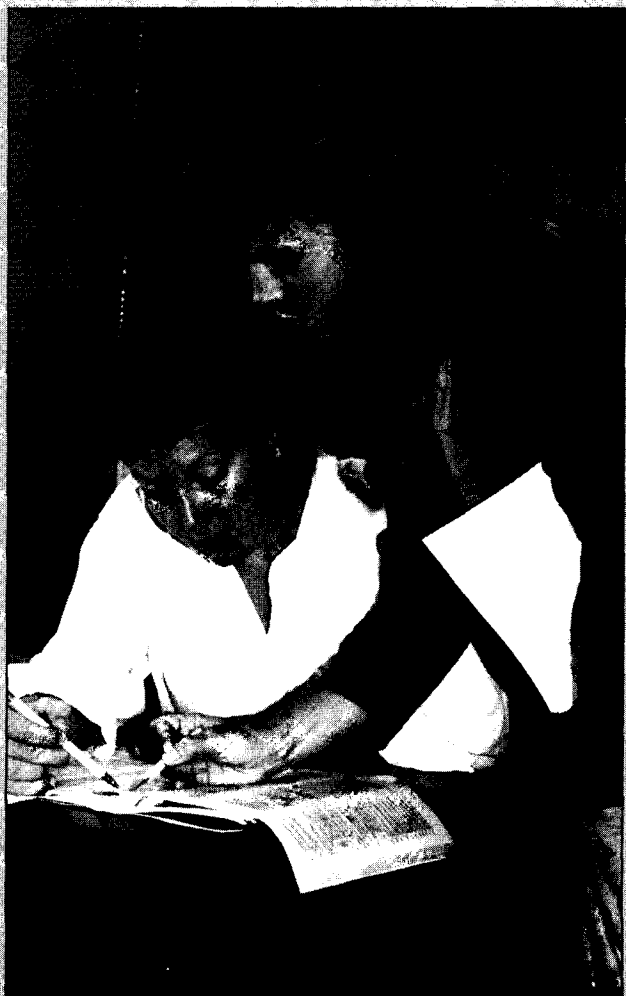
- BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
- Ent 5210—Integrated Pest Management (4)
- FW 3052—Introduction to Fisheries and Wildlife (3)
- ForP 1303—Wood Structure and Identification (3)
- FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
- FR 3232—Management of Recreational Lands (3)
- FR 3300—Elements of Surveying (2)
- FR 5110—Forestry Applications of Microcomputers (3)
- FR 5114—Forest Hydrology (3)
- FR 5121—Tree Physiology Laboratory (1)
- FR 5241—Natural Resource Management: Political and Administrative Processes (3)
- Hort 1036—Plant Propagation (4)
- Hort 1100—Biology of Horticultural Production (4)
- Hort 3072—Turf Management (4)
- Hort 5026—Landscape Management (5)
- IR 3010—The Individual in the Organization (4)
 - or IR 3002—Personnel and Industrial Relations (4)
 - or Jour 3159—Public Relations (4)
- LA 1031—Introduction to Landscape Architecture (4)
- Mgmt 3001—Fundamentals of Management (4)
- PA 5231—Strategy and Tactics in Project Planning (4)
- Pol 1027—Urban Politics (4)

Total Graduation Requirements—192 credits

Required courses listed above (147-149 credits), liberal education requirements in categories C and D (11 credits), and electives (32-34 credits).

¹Students who wish to take FR 5110 should not take GC 1571.

Course Descriptions



Course Descriptions

Course Numbering and Symbols—

Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School.

The following symbols are used throughout the course descriptions:

§ Credit will not be granted if credit has been received for the course listed after this symbol.

¶ Concurrent registration is allowed (or required) in the course listed after this symbol.

† All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.

Δ Registration Override Permit, completed and signed by the unit offering the course, is required for registration.

Registration Override Permit, completed and signed by the instructor, is required for registration.

When no abbreviated department prefix precedes the course number listed as a prerequisite, that prerequisite is in the same department as the course being described.

Agricultural and Applied Economics (AgEc)

1101. PRINCIPLES OF MICROECONOMICS.

(4 cr, §Econ 1002; prereq 1102)
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.

1102. PRINCIPLES OF MACROECONOMICS.

(5 cr, §Econ 1001)
Determinants of natural income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.

Agricultural Engineering Technology (AgET)

3030. INTRODUCTION TO PROBLEM SOLVING WITH COMPUTERS. (4 cr; prereq Math 1111 or equiv; 3 lect hrs, 1 rec hr per wk)
Elementary problem solving using computers. Writing programs in BASIC language. Use of timesharing terminals. Elements of computer hardware and software.

Chemistry (Chem)

1001-1002†. CHEMICAL PRINCIPLES AND COVALENT SYSTEMS. (5 cr per qtr, §1003, §1004-1005, §1008, §1031-1032)

Principles of chemical change; structural concepts of nuclei, atoms, molecules; laws of dynamic behavior of matter; equilibrium concepts, especially those relevant to living systems; application of principles with emphasis on organic and biological species.

1003. PHYSICAL WORLD CHEMISTRY. (5 cr, §any other college chemistry course)
Fundamental concepts of chemical bonding, structure of matter, and forces in the physical world. Scientific methods and principles that contribute to understanding the environment and problems faced in improving it. Lab.

1004-1005†. GENERAL PRINCIPLES OF CHEMISTRY. (5 cr per qtr, §1001-1002, §1003, §1031-1032)

Introduction to chemistry from the standpoint of atomic structure; periodic properties of elements and compounds derivable from structural considerations; laws governing behavior of matter; theories of solutions, acids, bases, and equilibria.

1006. PRINCIPLES OF SOLUTION CHEMISTRY. (4 cr; prereq 1005 or 1032; 3 lect and 4 lab hrs per wk)

The chemistry of selected cations and anions. Spectrophotometric, potentiometric, and chromatographic detection methods. Metal ion studies include systematics; acid-base principles; influence on the environment; importance in biological systems; formation and stereochemistry of complexes. Lecture and lab.

3301. ELEMENTARY ORGANIC CHEMISTRY I. (4 cr, §3331; for non-chemistry majors; prereq 1005 or 1032 or equiv; 4 lect hrs per wk)

Important classes of organic compounds, both aliphatic and aromatic, together with some heterocyclic compounds.

3302. ELEMENTARY ORGANIC CHEMISTRY II.

(4 cr; prereq 3301, 3305; 4 lect hrs per wk; if 3305 is taken concurrently, a passing grade is required for 3305 in order to receive cr for 3302)
Continuation of 3301.

3305. ELEMENTARY ORGANIC CHEMISTRY LABORATORY I. (2 cr; prereq 3301 or ¶3301; 1 lab conf and 4 lab hrs per wk)

Techniques used to prepare typical organic substances.

3306. ELEMENTARY ORGANIC CHEMISTRY LABORATORY II. (2 cr; prereq 3302 or ¶3302; 1 lab conf and 4 lab hrs per wk)

Techniques used to prepare typical organic substances.

Fisheries and Wildlife (FW)

1001. ORIENTATION IN FISHERIES AND WILDLIFE. (1 cr; S-N only)

Survey of technical requirements and education of fishery and wildlife technicians and scientists; introduction to fields of work, problems, and career opportunities.

1002. WILDLIFE: ECOLOGY, VALUES, AND HUMAN IMPACT. (3 cr)

Controversial issues involving specific wildlife management principles and techniques. Designed for students without natural science background interested in natural resource topics, especially wildlife issues.

1101. ETHICS AND VALUES IN RESOURCE MANAGEMENT. (3 cr)

Various aesthetic, economic, and ecological values of wildlife and fisheries resources. Short field exercises and class discussions will be directed at understanding the process and ethics of resource management and such controversies as sport, subsistence, and native peoples' harvest rights and genetic engineering.

1104. LIBRARY RESEARCH METHODS. (1 cr, §Rhet 1104; S-N only)

Lectures, computer modules, and in-library assignments designed to strengthen skills in using the library. Introduction to major types of library information resources and how to access them. This course serves as a prerequisite for Rhet 1151, 1222, and 3562.

3052. INTRODUCTION TO FISHERIES AND WILDLIFE. (3 cr)

Introduction to general ecological principles applied to management of fish and wildlife populations and their habitats; survey of legislation, agencies, and policy affecting vertebrate populations; natural history of important Minnesota game and nongame vertebrates.

3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT. (2 cr; prereq Δ; offered at Cloquet) Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.

3600. FISHERIES AND WILDLIFE FIELD TECHNIQUES. (5 cr; prereq 3052, Δ; given at Itasca)

Introduction to various field techniques and skills; planning and implementing field projects; data collection and analysis using microcomputers; written reports and a field journal.

5129. MAMMALOLOGY. (5 cr, §EBB 5129; prereq Biol 1106 or 3011 or #)

Recent families and orders of mammals of the world and genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.

5278. SPECIAL LECTURES IN WILDLIFE. (Cr ar; offered when feasible)

Lectures and/or laboratories in special fields of wildlife biology given by a visiting scholar or regular staff member.

5279. SPECIAL LECTURES IN FISHERIES. (Cr ar; offered when feasible)

Lectures and/or laboratories in special fields of fisheries biology given by a visiting scholar or regular staff member.

5393. SPECIAL PROBLEMS IN FISHERIES BIOLOGY. (Cr ar; prereq #)

Individual field, library, and laboratory research in fisheries biology.

5398. SPECIAL PROBLEMS IN WILDLIFE BIOLOGY. (Cr ar; prereq #)

Individual field, library, and laboratory research in wildlife biology.

5455. AQUACULTURE. (4 cr; prereq Biol 1009, 1103, 1106 or equiv, Chem 1001-2 or 1004-5 or equiv or #; offered alt yrs)

Role of aquaculture in resource management and world food production; institutional and economic considerations; principles of husbandry of aquatic organisms; interactions between fish metabolism and water quality; nutrition and energetics; fish health and genetics.

5459. PHYSIOLOGY AND BEHAVIOR OF FISHES. (3 cr)

Relationships among the physiology of fishes, their behavior, and the aquatic environment. Examination of ionic and osmotic balance, gas exchange, locomotion, orientation and migration, reproduction, endocrinology, growth, and stress.

5601. ASSESSMENT AND MANAGEMENT OF VERTEBRATE POPULATIONS. (5 cr; prereq 1101, 3052, FR 1201)

Conceptual models of populations, description of population characteristics, and computer-assisted estimation of population parameters for management purposes.

Course Descriptions

5603. ECOLOGY AND MANAGEMENT OF FISH AND WILDLIFE HABITATS. (4 cr; prereq 5601 or #)

Ecological analysis of environmental factors as they influence distribution, abundance, and productivity of terrestrial and aquatic vertebrates. Special emphasis on those factors subject to human influence.

5604. FISHERY AND WILDLIFE MANAGEMENT. (4 cr; prereq 5601 or #)

Basic understanding of fisheries and wildlife management with an emphasis on managed species of interest. Introduction to tactics and strategies of fisheries and wildlife management. Understanding of the role of strategic planning in directing and redirecting management actions. Use and efficacy of fisheries and wildlife management tools.

5610. RENEWABLE NATURAL RESOURCES AND PUBLIC POLICY. (2 cr)

Effect of public policy on leading issues in renewable natural resources. Primary focus is on U.S. Congress decision-making, secondary is on state and county government. Case studies. Role playing and development of practical skills.

5701, 5702†. SENIOR PROJECT. (1-2 cr; prereq FW sr or grad or #)

Two-quarter course providing problem-solving training. Management problem identification and analysis design, information and data gathering and analysis, and oral and written problem reporting. Problem selection influenced by guest speakers, resource agency contacts, and group discussions; topic selected is a contemporary fisheries and wildlife management issue.

5890. RESEARCH PROBLEMS AT ITASCA IN FISHERIES AND WILDLIFE. (Cr ar; prereq #)

Undergraduate students may develop a short-term research project during one or both summer terms.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8200. SEMINAR

8364. RESEARCH IN FISHERIES BIOLOGY

8377. RESEARCH IN WILDLIFE BIOLOGY

8448. FISHERY SCIENCE

8451. PRODUCTION BIOLOGY OF FISHERY ENVIRONMENTS

8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES

8459. STREAM AND RIVER ECOLOGY

8574. WILDLIFE MANAGEMENT: UPLAND GAME

8575. WILDLIFE MANAGEMENT: WATER-FOWL

8576. WILDLIFE MANAGEMENT: LARGE MAMMALS

8579. ECOSYSTEM ANALYSIS AND SIMULATION: A NUMERICAL APPROACH

Forest Products (ForP)

1001. FOREST PRODUCTS ORIENTATION. (1 cr)

Information about curricula offerings, specializations, career options, CLE requirements, financial aid, scholarships, summer employment, and other student-related concerns.

1100. WOOD IN AMERICAN LIFE. (3 cr; prereq Math 1111 or #)

Past, present, and future uses of wood. Types of products, quantities of wood used, import/export balances, forest resource situation, prospects of substitution for wood and environmental trade-offs, wood conversion efficiency and impacts on quantities needed, wood for energy, and proper wood product use.

1104. LIBRARY RESEARCH METHODS. (1 cr, §Rhet 1104; S-N only)

Lectures, computer modules, and in-library assignments designed to strengthen skills in using the library. Introduction to major types of library information resources and how to access them. ForP, FR, FW 1104—Library Research Methods (in lieu of Rhet 1104) serves as a prerequisite course for Rhet 1151, 1222, and 3562.

1301. WOOD AS A RAW MATERIAL. (4 cr)

The physical and chemical nature of solid wood and wood fiber as it relates to the requirements of major wood-based industries. World supply and consumption. Weekly demonstration labs dealing with structure and properties of wood and manufacture of solid, particle, and fiber products.

1303. WOOD STRUCTURE AND IDENTIFICATION. (2 cr; prereq 1301 or #)

Features of wood structure vital to identifying wood of various tree species and understanding physical properties of wood. Lecture and lab.

3202. LEADERSHIP AND MANAGEMENT SKILLS DEVELOPMENT. (2 cr)

Discussions and classroom exercises on management, planning, directing, controlling, and organization; group problem-solving, the implications of organizational change, time management, and career planning and development.

3300. WOOD INDUSTRY TOURS. (2 cr; prereq 1301; jr or sr standing or #)

A five-day bus tour of visits to a dozen or more manufacturers representing a broad cross section of the wood-using industry. Scheduled during spring quarter break.

3301. INDUSTRIAL INTERNSHIP. (2 cr; prereq FP cooperative education student)
Industrial work assignment in FP cooperative education program. Evaluation based on formal report written by student at end of each quarter of work assignment.

3303. FOREST PRODUCTS MARKETING. (3 cr)
Survey of marketing in the forest products industry, including review of basic marketing concepts and terminology.

3310. WOOD-FRAME BUILDING SYSTEMS AND MATERIALS. (4 cr; prereq Phys 1001 or equiv)
Light-frame construction methods and material selection with emphasis on wood-based products and components. Basic wood properties and products, cost estimating, building codes, construction practices, heat loss, and residential construction terminology.

3312. BUILDING MATERIALS ESTIMATING. (2 cr)
Modern methods of estimating quantity, grade, and specifications of building materials for light-frame construction.

3325. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq #)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the adviser for the project, a prospectus and completes progress reports and a final report on his or her project.

3361. INTRODUCTION TO ADHESIVES. (3 cr; prereq BioC 1301, Phys 1042; offered alt even yrs)
Scope and use of adhesive applications. Fundamental nature of adhesion; ideal adhesive joint. Adhesive polymers. Fabrication and mechanical properties of adhesively bonded assemblies.

5300. WOOD-FLUID RELATIONSHIPS. (3 cr; prereq 1301)
Moisture in wood and its relationship to density and specific gravity, shrinking and swelling, electrical properties, strength properties, thermoconductivity, sorption isotherms, dimensional stabilization, permeability and diffusion. Lectures only.

5301. MECHANICAL PROPERTIES. (3 cr; prereq 1301 or #)
Basic mechanics and strength of materials as applied to wood products.

5302. WOOD CHEMISTRY I. (3 cr; prereq Chem 3302)
Molecular structure of wood cell wall. Structures, properties, and reactions of monosaccharides and derivatives; oligosaccharides. Structure, properties, and biogenesis of cellulose; cellulose derivatives; comparison with starch.

5303. WOOD DETERIORATION. (3 cr; prereq 1301 or #)
Deterioration of wood and wood products by bacteria, fungi, insects, marine organisms, fire, and weathering; methods of preservation and preservatives used. Lecture and lab.

5304. WOOD DRYING AND PRESERVATION PROCESSES. (4 cr; prereq 5300, 5303)
Examination of materials, equipment, processes, and technical considerations inherent in the industrial drying and/or preservative treatment of wood products. Lectures, lab exercises, and plant visits.

5305. PULP AND PAPER TECHNOLOGY. (4 cr; prereq 5300 or #)
Pulping processes, fiber refining and processing, manufacture of paper; fiber and paper properties; paper recycling; water requirements and effluent treatment. Lecture and lab.

5306. ANALYSIS OF PRODUCTION SYSTEMS. (3 cr; prereq 1301 or #, 3300 recommended)
Engineering and economic analysis of manufacturing and distribution systems for wood-based products. Material balances, equipment selection, economic analysis, and presentation techniques.

5307. WOOD-BASE PANEL TECHNOLOGY. (4 cr; prereq 5300, 5301 or #)
Design, manufacture, properties, and applications of structural and nonstructural wood-base panels. Adhesives and their application in the panel industry. Lecture and lab.

5310. PULP AND PAPER PROCESS LABORATORY. (3 cr; prereq 5305 or #)
Chemical and mechanical pulping, pulp preparation, secondary fiber, de-inking, wet end additives. Lab problems and exercises supplemented by lectures.

5311. PULP AND PAPER PROCESS CALCULATIONS I. (4 cr; recommended prereq ME 3301, CE 3400, ChEn 5001, CSci 3101 or AgET 3030)
Physical and chemical process calculations; steady and unsteady state material and energy balances applied to pulping and papermaking processes; flowsheet and system calculations; computer-aided material and energy balances.

5312. PULP AND PAPER PROCESS CALCULATIONS II. (4 cr; prereq ForP 5311 or ChEn 5101, coreq ME 3301; CE 3400, ChEn 5001, Csci 3101 or AgET 3030 recommended)
Physical and chemical process calculations; steady and unsteady state material and energy balances applied to pulping and papermaking processes; flowsheet and system calculations; computer-aided material and energy balances.

Course Descriptions

5313. PULP AND PAPER PROCESS OPERATIONS. (4 cr; prereq ForP 5305, 5312, 5353, CE 3400, ME 3301, ME 5342 or ChEn 5102 or #)

Application of the principles of momentum, heat, and mass transfer to unit operations in the pulp and paper industry; fluid transport, filtration, sheet formation, sedimentation, drainage, pressing, heat exchange, evaporation, washing, bleaching, humidification and drying, chemical and energy recovery. Computer simulation of multiple-stage systems.

5315. PAPER ENGINEERING LABORATORY. (2 cr; prereq 5305, 5310 or ¶5310, 5312, or #; 5306 recommended)

Experiments that illustrate and apply the principles of momentum, heat, and mass transfer. Operation and performance optimization of pilot-plant paper machine. Process engineering studies of industrial production systems.

5316. COATED PRODUCT DEVELOPMENT.

(2 cr; prereq 5359)

Coating process and products (primarily paper); theory, techniques, and procedures for formulating and applying coatings; properties and uses of coated products.

5317. INSTRUMENTATION AND PROCESS CONTROL. (2 cr; prereq 5312)

Measurements, analog and digital control systems, instrumentation, computers, computer control, system maintenance, fluidics, special applications.

5331. UNDERGRADUATE SEMINAR. (2 cr;

prereq ForP major; must be taken before sr yr) Career planning, resume preparation, discussion of job interviewing, and practice of technical presentation.

5350. WOODY TISSUE MICROTECHNIQUE.

(2 cr; offered when feasible)

Use of sliding and rotary microtomes, maceration, differential staining, and special techniques in preparing woody tissue for microscopic study. Lab.

5353. WOOD CHEMISTRY II. (3 cr; prereq 5302)

Composition, distribution, and structures of hemicelluloses and their interactions with cellulose. Biosynthesis, structure, and analytical degradation of lignins. Wood delignification. Pulp bleaching chemistry. Lignin biodegradation.

5355. MECHANICS AND STRUCTURAL DESIGN WITH WOOD PRODUCTS. (4 cr; prereq 5301)

Mechanical behavior of lumber, plywood, and particleboard as applied to structural considerations in building construction. Lecture and lab.

5356. ADVANCED FOREST PRODUCTS MARKETING. (3 cr; prereq 3303 or #)

Marketing and market analysis, sales, and retail and wholesale distribution of forest products. Lectures and case studies.

5359. SURFACE AND COLLOID CHEMISTRY OF PAPERMAKING. (3 cr; prereq 5361 or #, Chem 3302, Chem 5520)

Principles of surface and colloid chemistry applied to basic problems in pulp and paper manufacturing operations and product uses.

5360. STRUCTURE AND PROPERTIES OF IMPORTANT TROPICAL WOODS. (2 cr; prereq 1303)

Structure and methods of identification of commercially important tropical woods. Properties and favored uses of these woods.

5361. ADHESION AND ADHESIVES. (3 cr; prereq Chem 3302, Chem 5520)

Scope and use of adhesive applications. Fundamental nature of adhesion; ideal adhesive joint. Conformations of linear polymers. Statistical thermodynamics and polymer adsorption onto adherend surface. Adhesives in common use. Mechanical properties of adhesive joints.

5401. SENIOR TOPICS. (Cr ar; prereq sr, #)

Independent study in a field of interest to a forestry major. Planned with adviser.

5405. PAPER IN TODAY'S WORLD. (3 cr, §5305; offered through CEE)

Intended primarily for elementary and secondary school teachers although other interested students may enroll. Enables teachers to prepare a teaching unit on pulp and paper for use in an elementary, junior high, or senior high school science class. Not open to Forest Products majors.

5410. USE OF WOOD MATERIALS IN BUILDING CONSTRUCTION. (4 cr; offered through CEE)

For architects, builders, contractors, building materials sales people, and do-it-yourselfers. Emphasizes the nature, properties, limitations, and proper use of wood products. Not open to Forest Products majors.

5415. DESIGN OF WOOD STRUCTURES. (4 cr; 5310 or equiv)

Wood structure engineering. Wood properties, strength and allowable stresses, durability, engineered wood products, behavior and design of beam and beam-columns, design of buildings and bridges, miscellaneous applications.

5417. RESIDENTIAL RETROFIT FOR COLD CLIMATES. (2 or 4 cr; recommended for secondary teachers of residential housing construction)

Methods for economic analysis and energy auditing with available software to aid in the analyses. Design and construction guidelines for the envelope given based on air infiltration-exfiltration, moisture transport, and heat loss. Influence of retrofitting on indoor air quality, practices to maintain a healthy environment and a sound structure. Principles in the choice and installation of heating, cooling, and ventilating systems. Integrated or systems approach to the design and construction of residential retrofit emphasized.

5420. USING PROCESS SIMULATION IN THE PULP AND PAPER INDUSTRY. (2 cr; offered through CEE)

This hands-on microcomputer two-day workshop provides instruction in solving flowsheet calculation problems relating to pulp and paper process engineering and demonstrations of the types of problems which can be solved using these techniques. Intended primarily for practicing engineers in the paper industry. Not open to Forest Products majors.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8300. RESEARCH PROBLEMS

8301. RESEARCH PROBLEMS

8302. RESEARCH PROBLEMS

8303. ADVANCED TOPICS IN PANEL PRODUCTS TECHNOLOGY

8304. ADVANCED TOPICS IN WOOD DRYING

8306. SEMINAR: FOREST PRODUCTS

8307. ADVANCES AND METHODS IN FOREST PRODUCTS PATHOLOGY AND PRESERVATION

8310. MECHANICS OF WOOD AND WOOD COMPOSITES

Forest Resources (FR)

1001. FOREST RESOURCES ORIENTATION.

(1 cr)

Information about curricula offerings, areas of emphasis, CLE requirements, and summer job and internship programs.

1100. DENDROLOGY. (4 cr; prereq Biol 1103)

Identification, nomenclature, classification, and distribution of about 200 important forest trees. Preparation and use of keys, systems of natural classification, and field and lab methods of identification.

1104. LIBRARY RESEARCH METHODS. (1 cr, §Rhet 1104; S-N only)

Lectures, computer modules, and in-library assignments designed to strengthen skills in using the library. Introduction to major types of library information resources and how to access them. ForP, FR, FW 1104—Library Research Methods (in lieu of Rhet 1104) serves as a prerequisite course for Rhet 1151, 1222, and 3562.

1110. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr)

Selected topics in Natural Resources.

1200. INTRODUCTION TO FOREST RESOURCES. (3 cr)

Multiple forest resources and their management. History, policy, and current issues in forest resources. Lectures and lab (including field trips).

1201. CONSERVATION OF NATURAL RESOURCES. (3 cr)

Development of thought on natural resource conservation in the United States. Renewable resources and their management problems; resource conservation and environmental management related to basic ecological principles.

1202. FARM AND SMALL WOODLANDS FORESTRY. (3 cr for non-forestry majors, 2 cr for majors [3 cr with paper]; prereq for majors 1100 or ¶1100)

Status and problems of the small woodland owner. Factors influencing tree growth. Cutting practices for and marketing products of small woodlands. Establishment and care of plantations, shelterbelts, and windbreaks. Field trips.

1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES. (3 cr, §1201; for non-forestry students)

Ecological, social, and economic implications of Minnesota's soil, water, forest, wildlife, and other resources are studied in field exercise and group discussions at nature centers and natural areas. Environmental teaching techniques for the elementary indoor classroom.

1300. INTRODUCTION TO FOREST COMMUNITIES. (2 cr; prereq soph, some plant identification, 1 biology course or #; given at Itasca)

Introduction to the soils, vegetation, wildlife, and ecologic dynamics of three forest communities in Itasca State Park. Five-day course offered during College of Natural Resources Itasca Session. For non-College of Natural Resources students only.

3100. MINNESOTA PLANTS. (2 cr; prereq Biol 1103, Δ; given at Itasca)

Identification of plants as related to habitat.

3101. FIELD FOREST ECOLOGY. (3 cr; prereq Chem 1001 or Chem 1004, Δ; given at Itasca)

Field examination of succession, soils, silvical characteristics, tree classification, stand structure, and regeneration ecology.

3102. SOUTHERN FOREST RESOURCE TOUR. (1 cr; prereq FR jr or sr or #; offered alt odd yrs)

One-week field tour of selected southern forest industries and public forest management agencies. Walnut production, southern pine silviculture, hardwood use, various mill tours. Discussions, paper.

3103. METEOROLOGY AND CLIMATOLOGY FOR NATURAL RESOURCE MANAGERS. (2 cr; prereq Phys 1001, Phys 1005 or #)

Fundamentals of meteorology and climatology as applied to wildland resource management.

Course Descriptions

3104. FOREST ECOLOGY. (3 cr; prereq Itasca Session or #)

Ecological concepts and principles as a basis for conservation and management of forest ecosystems.

3106. IMPORTANT PLANTS: FISHERIES AND WILDLIFE HABITATS. (1 cr; prereq FW 3600 or ¶3600; given at Itasca)

Field identification of important plants in fisheries and wildlife habitats.

3110. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr)

Selected topics in Natural Resources.

3201. FIELD FOREST MEASUREMENTS. (1 cr; prereq Math 1008, Δ; given at Itasca)

Introduction to land survey, tree and stand measurement, and basic forest sampling techniques.

3202. LEADERSHIP AND MANAGEMENT SKILLS DEVELOPMENT. (2 cr)

Discussions and classroom exercises on management, planning, directing, controlling, and organization; group problem solving, the implications of organizational change, time management, and career planning and development.

3225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq #)

Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the adviser for the project, a prospectus and completes progress reports and a final report on his or her project.

3232. MANAGEMENT OF RECREATIONAL LANDS. (3 cr)

Recreational use of the forest and associated land and water. Policy problems arising from recreational demands.

3250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2 cr)

International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overviews of issues and case studies.

3300. ELEMENTS OF SURVEYING. (2 cr; prereq Math 1008 or high school trigonometry, Δ; given at Cloquet)

Basic concepts of elementary plane surveying for use in natural resource assessment. Introduction to public land and boundary surveys and geographic information systems. Lectures and labs.

5100. SILVICULTURE. (3 cr; prereq Itasca Session, 1100, 3104 or #)

Introduction to silvics, forest regeneration and site preparation techniques, intermediate silvicultural practices, and silvicultural systems.

5101. FIELD SILVICULTURE. (4 cr; prereq 5100, Δ; given at Cloquet)

Regeneration surveys, plantation inspection, site preparation, and reforestation prescription. Practice in marking for thinning and determining effect on stands. Compartment examination and prescription. Written and oral reports.

5103. ADVANCED FOREST TREE BIOLOGY. (3 cr; prereq FR 3104)

Current applications and research in forest tree biology.

5104. FOREST ECOLOGY. (3 cr; prereq one course in biology or #)

Ecological concepts and principles as a basis for conservation and management of forest ecosystems.

5106. SENIOR SILVICULTURE SEMINAR. (2 cr [3 cr with research paper]; prereq sr, 5100 or #)

Students prepare, present, and critique seminars on silvicultural topics of interest. Guest speakers.

5110. FORESTRY APPLICATIONS OF MICRO-COMPUTERS. (4 cr; prereq Stat 3011, AgET 3030 or equiv)

Use of commercial microcomputer software to solve forestry problems, applications programming, workings of hardware components. Hands-on access to microcomputers as well as lectures.

5114. FOREST HYDROLOGY. (3 cr; prereq Itasca Session, 3103, Geo 1001 or #)

Introduction to the hydrologic cycle and hydrologic processes. Effects of forest management activities on water yield, storm flow, and water quality.

5115. FOREST HYDROLOGY, FIELD APPLICATIONS. (2 cr; prereq 5114, Δ; given at Cloquet)

Use of hydrologic instrumentation to measure precipitation, streamflow, infiltration capacity, soil moisture, air temperature, evaporation, and selected water quality constituents. Collection and interpretation of hydrologic information to evaluate forest-use impacts on water quantity and quality.

5120. INTRODUCTORY TREE PHYSIOLOGY AND GENETICS. (4 cr; prereq Chem 1001 or 1004, 10 cr Biol)

Genetic variation in forest trees, underlying causes, use. Tree growth, nutrition, and water relations. Environmental and internal growth regulation. Plant biochemistry and photo-chemistry. Physiology related to silviculturally and ecologically significant phenomena.

5121. TREE PHYSIOLOGY LABORATORY. (1 cr; prereq 5120 or ¶5120)

Lab study tree biology. Emphasis on design and conduct of experiments.

5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS. (2 cr; prereq 1020, 5100, Δ; given at Cloquet)

Field examination of forest soils and their relationship to site productivity and forest management.

5130. GEOGRAPHIC INFORMATION SYSTEMS IN NATURAL RESOURCE ANALYSIS. (3 cr; prereq sr or grad or #)

Introduction to the application of Geographic Information Systems (G.I.S.) to natural resource and regional planning studies. Theory and technical points; emphasis on applications. Hands-on experience with microcomputer. Case study, including map digitizing, data processing, and generation of map products.

5140. APPLICATION OF SILVICULTURE IN NORTH AMERICAN FOREST TYPES. (3 cr; prereq 5100 or #)

Current regeneration methods and intermediate stand treatments. Economic and biological principles. Primarily lectures. Student presentations, discussion of current literature, and field trips may also be included, depending on enrollment.

5152. FOREST GENETICS. (3 cr; prereq sr or #)

Genetic variation of forest-tree species and underlying principles; application of plant breeding principles to forestry.

5153. ADVANCED FOREST HYDROLOGY. (4 cr; prereq 5114 or #)

Current hydrologic problems in the management of forested watersheds. Analytical methods to evaluate effects of vegetation management on the quantity and quality of runoff. Lecture and lab.

5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS. (3 cr; prereq grad, #; given at Itasca)

Plant identification, plant dynamics, land survey, tree measurement.

5200. AERIAL PHOTO INTERPRETATION. (3 cr)

Types, characteristics, procurement, preparation, viewing, and interpretation of color, black-and-white, and color infrared aerial photographs; basic aerial photography; introduction to mapping; applications to resource surveys.

5212. NATURAL RESOURCES INVENTORY.

(3 cr; prereq Itasca Session, AgET 3030 or equiv computer programming course with FORTRAN or BASIC language, Math 1142 or Math 1211, Stat 3011 or Stat 5021)

Measurement of stand variables, forest products, forest growth and yield. Elementary statistics. Sampling methods for estimating characteristics of natural resources and resource use for management decision-making. Lecture and lab.

5215. FOREST FIRE MANAGEMENT. (2 cr;

prereq 1100, Itasca Session, 3103, 5100 or #)
Concepts, principles, and techniques of fire control and use in wildland management.

5216. SPECIAL TOPICS IN FOREST FIRE MANAGEMENT. (Cr ar; prereq 5215 or #)

Independent study in a selected aspect of forest fire management.

5217. FIELD TECHNIQUES FOR PRESCRIBED BURNING. (1 cr; prereq 5215 or #; S-N only)

Field exercises in prescribed burn planning and execution.

5218. FIELD TECHNIQUES FOR FOREST FIRE CONTROL. (1 cr; prereq 5215 or #)

Supervised experience in presuppression and suppression activities.

5220. REMOTE SENSING, FOREST RESOURCES INVENTORY. (4 cr; prereq 5200, 5212, Δ; given at Cloquet)

Use of aerial photographs in property boundary location; interpretation and classification of forest vegetation types. Application of sampling methods for estimating natural resources and resource use for management decision-making.

5221. PLANT MOLECULAR EVOLUTION. (3 cr; prereq Biol 5003 or GCB 3022 or GCB 5022; equiv to PBio 5221)

Experimental molecular techniques applicable to evolutionary studies. Molecular methods of quantifying genetic diversity. Statistical methods for phylogenetic reconstruction. Application of RFLPs to the study of chromosomal evolution. Application of RFLPs to the study of morphological evolution. Evolution of organellar genomes. Evolution of multigene families. Role of transposable elements in plant evolution. DNA sequence evolution. Molecular aspects of development as related to plant evolution.

5226. FOREST ECONOMICS AND PLANNING. (5 cr; prereq 5212, AgEc 1101 or #)

Conduct and interpretation of economic analysis; forest planning concepts, principles, and techniques of forest regulation.

5231. RANGE MANAGEMENT. (3 cr; prereq Biol 1103 or #)

Important range plants; range livestock; range management methods and improvements; public grazing land administration; relationship of livestock grazing to wildlife, forest, watershed, and recreation management on public and private range lands.

5233. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING. (4 cr; prereq 3232 or #)

(Same as LA 5010) For advanced students associated with design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, summer and winter recreational facilities.

5236. FOREST RECREATION PLANNING.

(1 cr; prereq 3232, Δ; given at Cloquet)
Recreation area and site planning, examples and managerial concerns. Fieldwork and presentation.

Course Descriptions

5240. NATURAL RESOURCE POLICY AND ADMINISTRATION. (3 cr; prereq For jr or sr or #)

Basic concepts of political and administrative processes in developing natural resource policies and programs. Policy processes, agenda setting, political decision rules, strategies for achieving agreement, participants in policy development, public means of implementing policies, and case examples.

5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES. (3 cr; prereq 5240 or #)

Advanced concepts of political and administrative processes important to developing natural resource policies and programs. Issue creation and agenda-setting theories, incremental decision-making styles, role of analysis and analytical information, actions of major policy participants (e.g., courts, legislatures, interest groups, media), program planning, budgeting and staffing, and evaluation of natural resource case studies.

5248. HARVESTING AND ENGINEERING. (3 cr; prereq CE 3100 or FR 3300, Δ; given at Cloquet)

Introduction to harvesting systems, relationship to forest management, and preparation and administration of timber sales. Fundamentals of location, construction, and maintenance of forest roads.

5250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2 cr)

International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overview of issues and case studies. Term paper, other requirements.

5253. FOREST BIOMETRY. (3 cr; prereq 5212, Stat 5021 or #; offered alt even yrs)

Topics in forest measurements and the modelling and analysis of forest characteristics, with emphasis on growth and change estimation.

5255. FOREST RESOURCE SURVEY DESIGN. (3 cr; prereq 5212, Stat 5021 or #; offered alt odd yrs)

Advanced forest measurements, sampling, and survey design concepts and practices.

5257. RECREATION LAND POLICY. (3 cr; prereq 3232 or #)

Policy issues affecting the use and management of lands devoted entirely or in part to recreational objectives.

5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR. (3 cr; prereq 3232, RRM major or grad or #)

Development of environmental framework for understanding recreation behavior. Contributions of several disciplines, current cultural trends, management implications.

5262. REMOTE SENSING OF NATURAL RESOURCES. (4 cr)

Introduction to remote sensing for natural resource inventories, land-use analyses, and environmental monitoring activities; photographic, thermal, multispectral, and radar-sensing procedures; airborne and satellite systems; visual and computer-assisted analysis techniques; oriented toward an interdisciplinary audience.

5264. QUANTITATIVE TECHNIQUES IN FOREST MANAGEMENT. (3 cr; prereq 5212, 5226 or #)

Forestry applications of quantitative techniques in allocation and other decision-making problems. Mathematical programming, simulation, and other techniques.

5269. INTERDISCIPLINARY SEMINAR I. (4 cr)

Resource and community development analysis, implications for resource allocation. Selected speakers, readings, and discussion topics. Diverse disciplinary contributions reflected.

5270. INTERDISCIPLINARY SEMINAR II.

(4 cr)

Development of ability to identify and analyze resource development problems. Student participation as team members; guest speakers. Diverse disciplinary contributions reflected.

5401. SENIOR TOPICS. (Cr ar; prereq Nat Res sr or #)

Independent study in a field of interest to the student. Work must be planned with a Natural Resources faculty member.

5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION. (3 cr; offered through CEE)

Intended for elementary teachers. Study of soil, water, forest, and wildlife resources of Minnesota and the biological principles and ecological implications of management. Discussion of environmental issues developed through natural resource manipulation. Development of outdoor teaching skills in environmental education in a metropolitan center.

5406. FORESTRY WORKSHOP FOR TEACHERS. (3 cr; prereq Δ; given at Cloquet)

Forest ecosystems and forest management studied in lecture and lab sessions conducted in a forest environment. In field exercises, techniques and materials are developed for teaching principles of forestry in indoor and outdoor classrooms. Tours to forest and wildlife research and management units and use locations, and discussions of contemporary forestry issues by guest lecturers.

5408. FORESTRY IN THE URBAN ENVIRONMENT. (3 cr; prereq student teacher, teacher or #)
Study of forest ecosystems and forest management in lecture and lab sessions. Field exercises emphasize techniques and materials useful for teaching principles of forestry in indoor and outdoor classrooms; forest areas in the Twin Cities used for field exercises. Special uses and problems of the urban forest. Discussions and presentations by guest lecturers on contemporary forestry issues.

5412. ADVANCED REMOTE SENSING. (4 cr; prereq 5262 or #)
Working knowledge of quantitative remote sensing. Both theoretical basis and practical aspects, including energy-matter interactions, radiation measurements and sensors, and digital image analysis.

5458. WATER QUALITY MANAGEMENT: ECOSYSTEM APPROACHES. (4 cr; prereq Chem 3101, Biol 5041 or equiv or #)
Anthropogenic influences on aquatic ecosystems. Influences include forest management, point and non-point pollution, and acid rain.

5500. URBAN FOREST MANAGEMENT. (3 cr; prereq 5100 or #)
Discussion and development of basic concepts. Introduction to terminology and principles of urban tree inventory, propagation, and care; management case studies; equipment operation and costs.

5501. URBAN FOREST ADMINISTRATION. (3 cr; prereq 5100, 5500 or #)
Discussion and development of basic concepts; introduction to public relations, program building; staffing and labor relations; effect of legal restraints on ordinances and contracts; budget monitoring.

5550. ETHICS IN NATURAL RESOURCE MANAGEMENT. (2 cr; prereq soph, jr, sr or grad or practicing professional or #)
The "social reality of ethics." Why ethics are important. Understanding ethics as a focus of objective inquiry. Relating ethical positions to standards or guidelines for individual behavior. The ethical basis for attitudes toward natural resources. Defining ethical issues and dilemmas. Environmental ethics: the preservation perspective. Major schools of thought and their rationale. Humanistic and naturalistic approaches. Environmental ethics: the commodity perspective. The professional's role. Examples of ethical issues and dilemmas from the "real world" of administration and management.

5700. COLLOQUIUM IN FOREST BIOLOGY. (1-2 cr; prereq varies with topic, #)
Colloquium on specialized topics in forest biology and silviculture.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8100. RESEARCH PROBLEMS: SILVICULTURE

8101. RESEARCH PROBLEMS: FOREST-TREE PHYSIOLOGY

8102. RESEARCH PROBLEMS: FOREST-TREE GENETICS

8103. RESEARCH PROBLEMS: FOREST HYDROLOGY

8105. ADVANCED FIELD SILVICULTURE

8106. TOPICS IN SILVICULTURE-FOREST SOILS

8107. SEMINAR: FOREST RESOURCES

8200. RESEARCH PROBLEMS: FOREST MANAGEMENT

8201. RESEARCH PROBLEMS: FOREST ECONOMICS

8202. RESEARCH PROBLEMS: FOREST BIOMETRY

8203. RESEARCH PROBLEMS: FOREST RECREATION

8204. RESEARCH PROBLEMS: FOREST POLICY

8205. RESEARCH PROBLEMS: REMOTE SENSING

8207. ECONOMIC ANALYSIS OF FORESTRY PROJECTS

8210. RESEARCH METHODS IN FORESTRY

8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES

8213. TOPICS IN WILDLAND HYDROLOGY

Mathematics (Math)

1008. TRIGONOMETRY. (4 cr; prereq plane geometry, 2 yrs high school algebra or ¶1111, plane geometry, grade of C or better in 0009)
Analytic trigonometry, identities, equations, properties of trigonometry functions; right and oblique triangles.

1111. COLLEGE ALGEBRA AND ANALYTICAL GEOMETRY. (5 cr, \$1201; prereq plane geometry and 2 yrs high school algebra or plane geometry, grade of C or better in 0009)
Functions, graphs, quadratic equations, progressions, inequalities, complex numbers, theory of equations, permutations and combinations, probability, systems of equations, determinants, graphing of linear and quadratic equations, conics and standard position, logarithms.

Course Descriptions

1131. FINITE MATHEMATICS. (5 cr; prereq 3½ yrs high school math or grade of C or better in 1111) Elementary computer programming, financial mathematics, probability, linear algebra, linear programming, Markov chains.

1142. SHORT CALCULUS. (5 cr; for students requiring minimal amount of calculus; prereq 3½ yrs high school math or grade of C or better in 1111 or 1201)

Derivatives, integrals, differential equations, maxima and minima, partial differentiation, applications.

1201. PRE-CALCULUS. (5 cr, §1111; for students needing to review high school higher algebra and trigonometry before taking calculus; prereq 4 yrs high school math including trigonometry) Inequalities, analytical geometry; complex numbers, binomial theorem, mathematical induction; functions and graphs; trigonometric, exponential, and logarithmic functions.

1211-1221. CALCULUS I-II. (5 cr per qtr; prereq 4 yrs high school math including trigonometry or grade of C or better in 1201 or grade of C or better in 1008 and 1111 or equiv; grade of C or better required to continue in sequence)

Analytical geometry and calculus of functions of one variable, applications.

1241. LINEAR AND NONLINEAR MULTIVARIABLE ANALYSIS I. (5 cr; prereq grade of C or better required to continue in sequence)

Linear algebra, geometry, and linear transformations in two-, three-, and more generally, n-dimensional space; curves; limits and continuity in the multivariable setting.

3221. INTRODUCTION TO LINEAR ALGEBRA AND LINEAR DIFFERENTIAL EQUATIONS.

(5 cr, §3066, §3142, §3511; prereq grade of C or better in 1231 or equiv)

Vectors, systems of linear equations, matrices, determinants, bases, eigenvalues. Linear differential equations and systems with constant coefficients, initial value problem and general solution, variation of parameters for inhomogeneous equations.

3311. LINEAR AND NONLINEAR MULTIVARIABLE ANALYSIS II. (5 cr; prereq grade of C or better required to continue in sequence)

Differentiation, extreme values, and integration of functions of several variables.

3321. DIFFERENTIAL EQUATIONS AND GENERAL VECTOR SPACES. (5 cr; prereq grade of C or better required to continue in sequence)

Vector spaces, especially vector spaces of functions; linear transformations and eigenvalues; first order differential equations; linear differential equations and linear differential systems. Recommended but not required that 3311 be taken first.

3331. INFINITE SEQUENCES AND SERIES; VECTOR INTEGRAL CALCULUS. (5 cr; prereq grade of C or better required to continue in sequence) Convergence issues and calculational techniques for infinite sequences and series; line and surface integrals, the divergence theorem and the theorems of Green and Stokes. Recommended but not required that 3311 be taken first.

Natural Resources and Environmental Studies (NRES)

1001. ORIENTATION TO NATURAL RESOURCES AND ENVIRONMENTAL STUDIES.

(1 cr; S-N only)

Information about NRES major. Discussions with faculty adviser. Employment information. Current topics in NRES. Information about facilities. Discussions with alumni.

1010. ISSUES IN THE ENVIRONMENT. (3 cr)

Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design providing maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 20 taped lectures and 10 discussion periods.

1040. NATURAL RESOURCES AS RAW MATERIALS. (2 cr)

Role of natural resources as raw materials for industry and economic development. Environmental and economic trade-offs associated with raw material gathering, processing, and use. Implications of processing technologies, energy considerations.

3001. COLLOQUIUM IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES.

(1 cr)

Round table discussions of current topics in Natural Resources and Environmental Studies.

3050. EXPERIENCE AND TRAINING IN A FIELD SETTING. (1-4 cr; prereq jr or sr standing)

Students are required to obtain professional experience in a field setting by attending field sessions, completing a Professional Experience Program, or volunteering for various Natural Resource and/or Environmental programs through local state or federal agencies. Approval by an adviser required.

3099. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES I. (1 cr; prereq sr standing or #)

Designed to help students identify and analyze Natural Resources and Environmental problems. Identify a problem and develop a working plan for a solution. Students participate as a team.

3100. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES II. (3 cr; prereq 3099)

Development of a solution to the problem identified in 3099. Discussions reflect diverse aspects of the problem and assignments. Oral and written presentations. Students participate as a team.

5210. SURVEY, MEASUREMENT, AND MODELING METHODS FOR NATURAL RESOURCES. (3 cr; prereq Math 1142, Stat 3011 and computer competency)

Introduction to survey design, measurement concepts, and modelling methods useful in the study of natural resources and environmental issues. Emphasis on data collection and analysis.

Physics (Phys)**1001. THE PHYSICAL WORLD.** (4 cr, \$any other physics courses except 1061)

Conceptual introduction to modern discoveries and theories in physics; discussion of their applications and importance in today's society. Relativity, cosmology, atomic physics, nuclear physics, solid state physics, superconductivity, computers, lasers, quarks, and unification theory. Development of classical background as needed.

1005. PHYSICS LABORATORY. (1 cr; prereq 1001 or ¶1001; S-N only)

Lab experiments offered with 1001.

1041-1042. INTRODUCTORY PHYSICS. (4 cr per qtr, \$any other intro physics courses)

Lectures and problem sessions. Mechanics, fluids and gases, heat, waves, electricity and magnetism, light, optical instruments, atoms and spectra, nuclei, radioactivity. Associated labs are 1045-1046.

1045-1046. INTRODUCTORY PHYSICS

LABORATORY. (1 cr per qtr; prereq for 1045—1041 or ¶1041, prereq for 1046—1042 or ¶1042; S-N only)
Lab experiments offered with 1041-1042.

1271-1281-1291. GENERAL PHYSICS. (4 cr per qtr; prereq completion of or concurrent registration in Math 1221 or 1521 or 1621 or equiv for 1271, completion of or concurrent registration in Math 1231 or 1531 or 1621 or equiv for 1281; may be taken with or without accompanying lab 1275-1285-1295; 4 lect and 1 quiz hrs per wk)
Calculus-level general physics course.

1271: Mechanics.

1281: Heat, electricity.

1291: Magnetism, optics.

1275-1285-1295. GENERAL PHYSICS LABORATORY. (1 cr per qtr; S-N only; prereq 1271-1281-1291 or §1271-1281-1291 or 1311-1321-1331-1341 or §1311-1321-1331-1341; 2 lab hrs per wk)

Lab exercises offered with 1271-1281-1291 and 1311-1321-1331-1341.

Rhetoric (Rhet)**1101. WRITING TO INFORM AND PERSUADE.** (4 cr, §Comp 1011; prereq ¶1104)

Relationship of fact finding and clear thinking to informative and persuasive writing. Importance of thesis sentence, evidence, coherence, clarity, and correctness. Relatively short (500-750 words) assignments designed to complement instruction in the Library Laboratory.

1104. LIBRARY RESEARCH METHODS. (1 cr; S-N only; taught by St. Paul campus library staff)
On-site instruction in information retrieval techniques. Lectures, audiovisual presentations, and problem-solving assignments designed to strengthen skills in using the library.

1101. WRITING IN YOUR MAJOR. (4 cr; prereq 1101, 1104, soph status)

Students investigate and write on subjects related to their majors. The criterion of appropriateness: good writing meets the expectation of readers and the conventions of a particular form. Assignments such as literature review, abstract, fact sheet, instructions, and feature article.

1222. PUBLIC SPEAKING. (4 cr; prereq 1101, 1104)

Fundamentals of speechmaking. Emphasis on organizing the speech and projecting it to the audience.

3254. ADVANCED PUBLIC SPEAKING. (4 cr; prereq 1222)

Training for specific speech situations most likely to be encountered professionally. Emphasis on analysis, design, preparation, and delivery of presentations to provide greater flexibility within a variety of speech environments.

3266. COMMUNICATION, DISCUSSION IN SMALL GROUP DECISION-MAKING. (4 cr; prereq 1101)

Role of communication techniques in the small group decision-making process. Emphasis on discussion within a variety of decision-making modes such as voluntary groups, business meetings, and conflict groups.

3562. WRITING IN YOUR PROFESSION. (4 cr; prereq 1101, 1104, 1151, jr status)

Projects in professional writing. Relationship between structuring information to meet needs of particular readers and writing effectively. Assignments such as the feasibility report, proposal, memorandum, letter of application, and resume.

Course Descriptions

Soil Science (Soil)

1020. THE SOIL RESOURCE. (4 cr; prereq Chem 1001 or 1004)

Introduction to the physical, chemical, and biological aspects of soils. Use of the soil classification system to understand the use of soil survey information for land-use planning. Concepts of soil fertility for understanding plant growth requirements. Introduction to urban soils and their management. Understanding soil's role in environmental planning and conservation decisions.

5710. ADVANCED FOREST SOILS. (3 cr [4 cr with paper]; prereq 1020, FR 5114)

Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

Statistics (Stat)

3011. STATISTICAL ANALYSIS. (4 cr; prereq college algebra)

3012. STATISTICAL ANALYSIS. (4 cr; prereq 3011)

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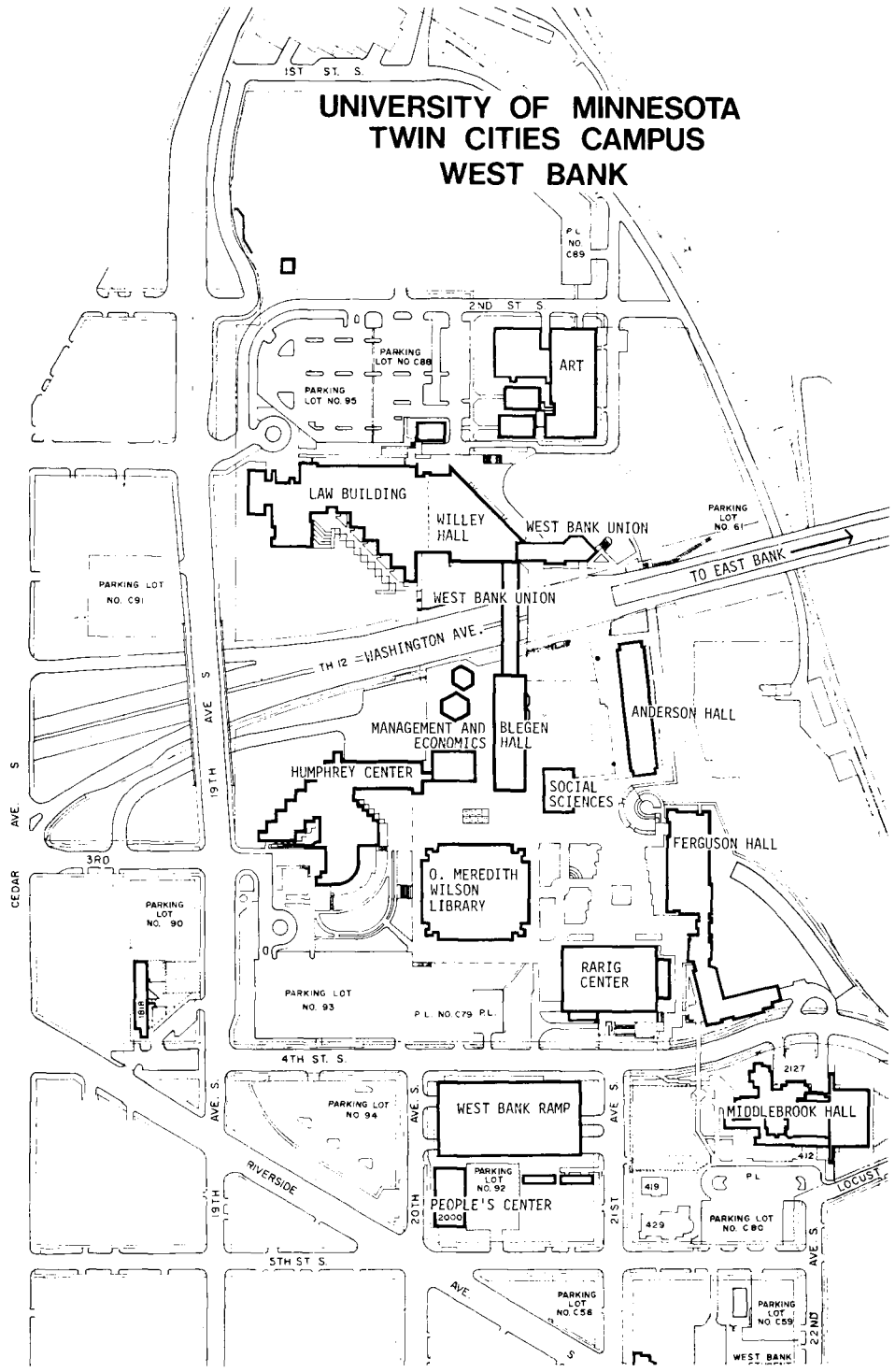
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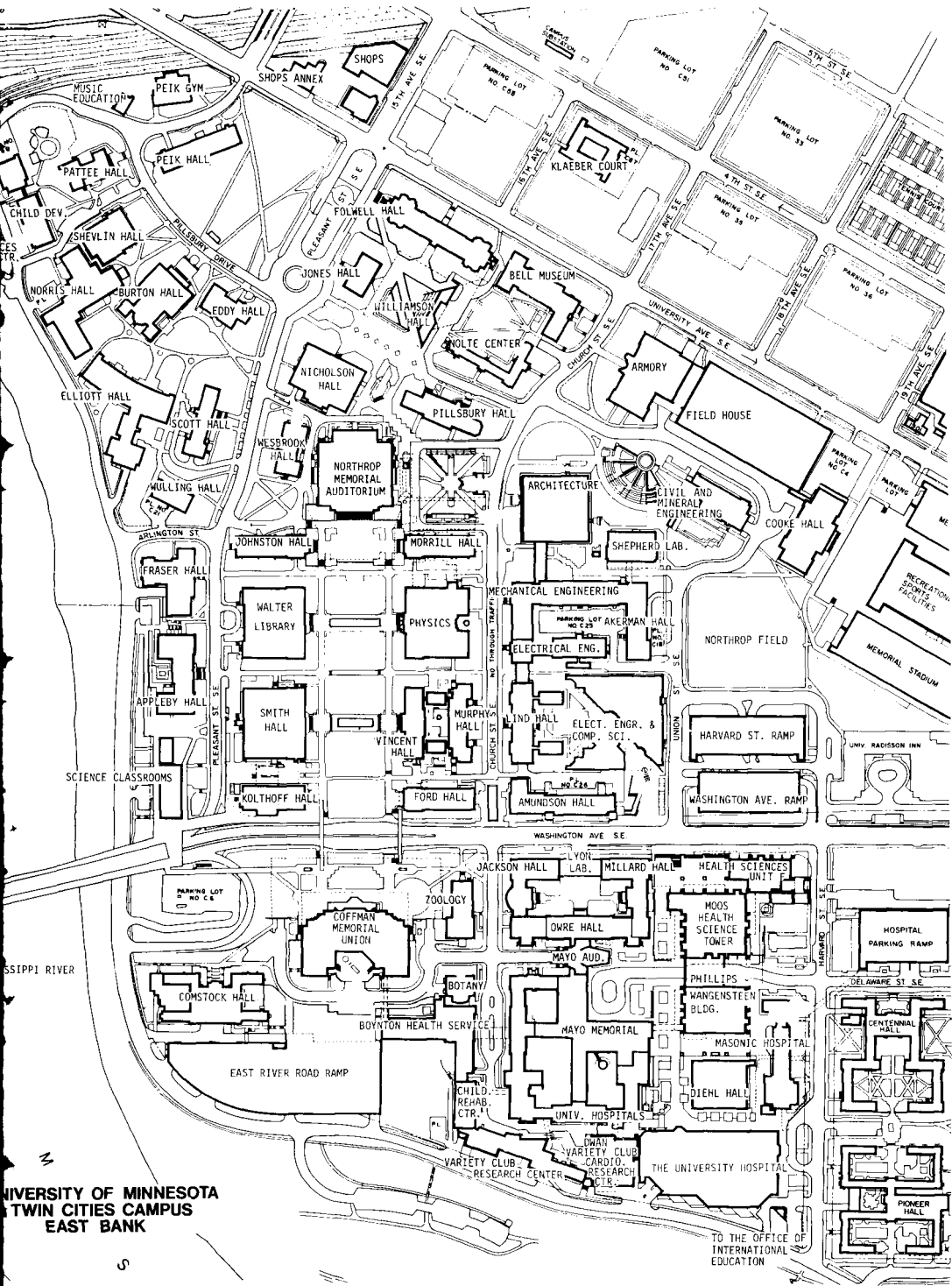
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¹⁴from USDA Forest Service North Central Forest Experiment Station

¹⁵Recipient of the Horace T. Morse-Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education

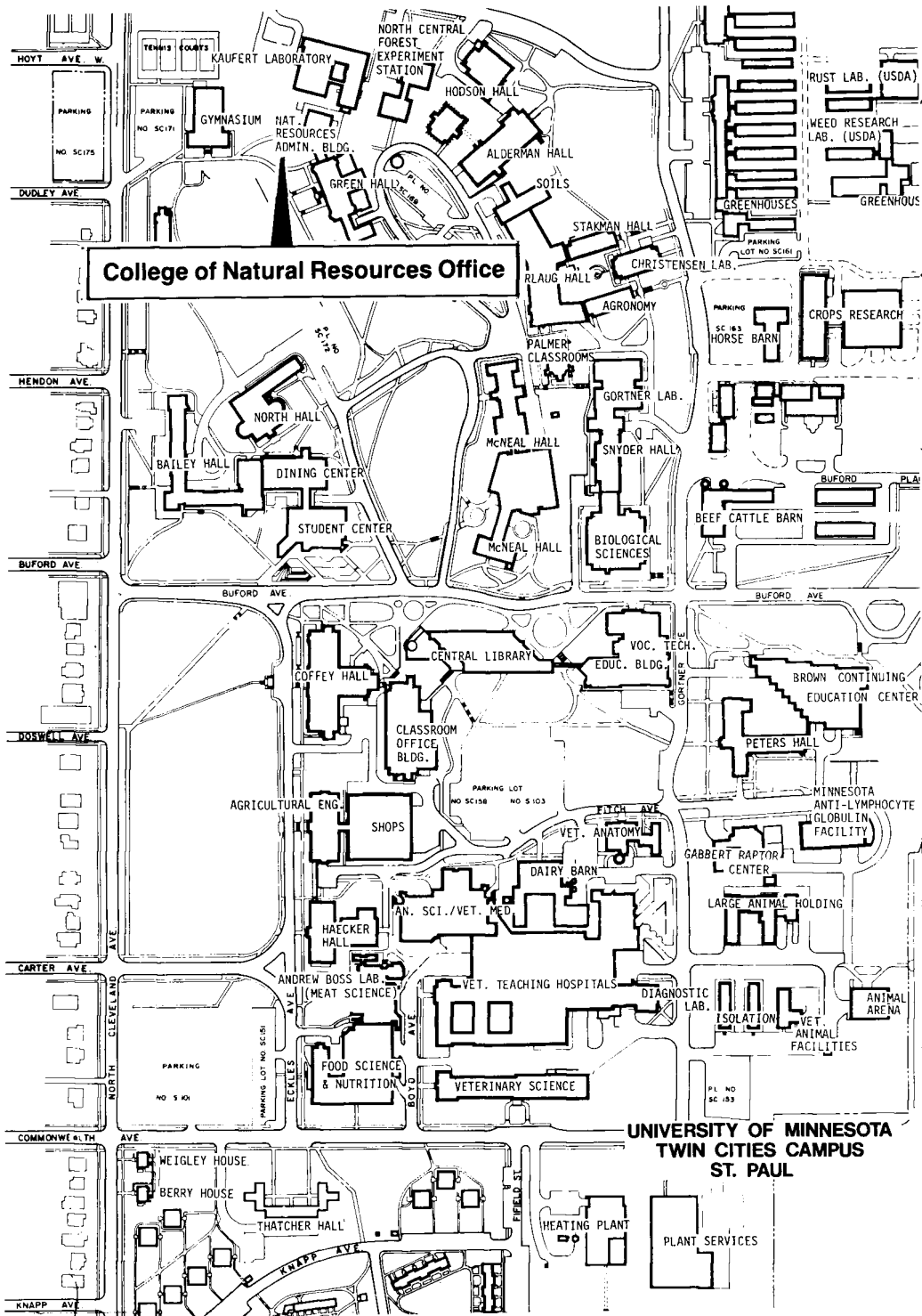
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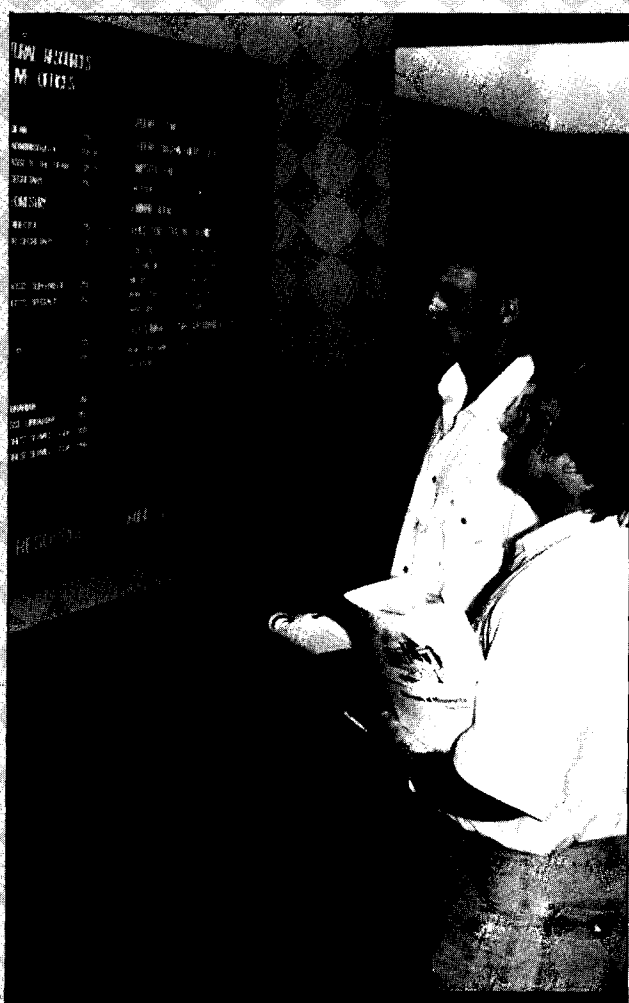
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