

Forestry
University of Minnesota Bulletin
1986-88



Forestry

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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, or veteran status. In adhering to this policy, the University abides 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; by 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 addressed 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 (612/373-7969); 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 and honors received, and degrees earned—is considered public or directory information. To prevent release of such in-

formation 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 Coordinator of Student Support Services, 260e Williamson Hall (612/373-2106).

Postal Statement

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Cover Photo: A student uses a stereoscope in the Remote Sensing Lab to view aerial forest resource photography.

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 renewable natural resources. The uses, management, and protection of forest, fish, and wildlife resources are the focus of curricula in Forest Products, Forest Resources, Renewable Resource Science, Recreation Resource Management, Urban Forestry, and Fisheries and Wildlife. These programs are designed to help students integrate scientific knowledge with the management and communication skills necessary for professional success.

Forests, 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, social, and cultural well-being of each of us. If you would like to help make the most of these resources now and in the future, I am sure you will find this bulletin presents some interesting opportunities for preparing for such a role.

The College of Forestry 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 and cultural resource.



A handwritten signature in cursive script that reads "Richard A. Skok".

Richard A. Skok
Dean, College of Forestry

Introduction

Placement

Placement of graduates is a concern for any prospective or currently enrolled College of Forestry student. It may come as a surprise to learn that some 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 Paper Science and Engineering graduates range from \$28,000 to \$30,000 per year.

Forest Resources and Fisheries and Wildlife graduates face a more competitive job market. Graduates from curricula in these departments can enhance their success in finding employment upon graduation by (1) being flexible in choosing where to work, e.g., southern United States; (2) maintaining above average academic records; and (3) gaining related work experience before graduation. Starting salaries for Forest Resources and Fisheries and Wildlife graduates typically range from \$15,000 to \$20,000 per year.

The College of Forestry helps students locate summer jobs in fisheries and wildlife, forestry, and forest products as well as permanent employment following graduation. Placement services for Fisheries and Wildlife and Forest Resources students are provided by the career opportunities coordinator in 110j Green Hall. Students in the Forest Products Paper Science and Engineering specialization receive assistance in 102 Kaufert Lab; all other Forest Products students, in 240 Kaufert Lab. Faculty providing placement service advise students on carrying out job searches, publicize openings, help arrange interviews, and periodically hold information meetings.

General Information



General Information

Mission

The College of Forestry—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 Forestry 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 half a century. 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 products from wood. The newest curriculum addresses the urban environment and management of tree cover to contribute to people's needs.

Facilities

The College of Forestry is based in three buildings on the St. Paul campus: Green Hall, the Kaufert Laboratory of Forest Products and Wood Science, and Hodson Hall. Green Hall houses the Dean's Office, Office of Student Services, Forest Resources Department, Forestry Library, and Remote Sensing Laboratory. The Forest Products Department is in the Kaufert Laboratory, which has well-equipped laboratories for teaching and research in such areas as 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 Forestry 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. The state park, Minnesota's largest, 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, Renewable Resource Science, 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 offered to students.

Degrees Offered

Baccalaureate Degrees—The bachelor of science (B.S.) degree is awarded to College of Forestry students who satisfactorily complete 192 required and elective credits in one of seven major programs: Fisheries, Wildlife, Forest Products, Forest Resources, Renewable Resource Science, Recreation Resource Management, or Urban Forestry. 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, and the master of forestry (M.F.) degrees are offered through the Graduate School in cooperation with the College of Forestry. For detailed information, consult the appropriate Director of Graduate Studies (110b Green Hall, 373-0833, for Forestry; 200 Hodson Hall, 373-3028, 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 (373-2973).

Administration

The undergraduate curricula of the College of Forestry are organized within three academic departments—Fisheries and Wildlife (200 Hodson Hall); Forest Products (203 Kaufert Lab); and Forest Resources (110 Green Hall), which also offers the Renewable Resource Science, Recreation Resource Management, and Urban Forestry programs. The chief administrator of each department is the department head.

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

The college's Office of Student Services, 10 Green Hall, provides admission, registration, advising, placement, and other assistance to all undergraduate students.

Admission

Students seeking admission to the College of Forestry as undergraduates should apply through the Office of Admissions and Records, 130 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (373-0707). A \$20 nonrefundable application fee is required.

Freshman Admission—High school graduates must submit scores from the Preliminary Scholastic Aptitude Test (PSAT), Scholastic Aptitude Test (SAT), or American College Testing (ACT) program along with their high school rank percentile (HSR). High school courses required by the College of Forestry are 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.

The College of Forestry uses the following admission criteria:

<i>Formula</i>	<i>Minimum Score</i>
HSR Percentile + PSAT	
Verbal + PSAT Math	140
HSR Percentile + (SAT	
Verbal ÷ 10) + (SAT Math ÷ 10)	140
HSR Percentile + (2 x ACT	
Composite score)	100

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 such factors 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 Forestry programs. Most students find they must

General Information

transfer before their junior year to meet residence and upper-level course requirements of the College of Forestry.

Credits earned through special examination, Continuing Education and Extension, or adult special enrollment may also be eligible for transfer to the College of Forestry.

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.

Field Session Fees

The 1985 costs for the College of Forestry field training sessions at Itasca and Cloquet are stated below. All charges are subject to review and revision, with yearly increases almost inevitable. (The annual *General Information Bulletin* contains residence regulations and the most current and complete breakdown of tuition and fees charged for the academic year.)

Itasca Session

Cost per 3½-week Summer Term (1985)

Resident and Nonresident Tuition

\$233.40 (sophomores)

\$327.18 (juniors, seniors)

Health Fee \$21.05

Recreation Fee 3.15

An additional fee is assessed for cabin rental. Meals are provided at cost through a student cooperative.

Cloquet Session

Cost per Fall Quarter (1985)

Resident Tuition 763.42

Nonresident Tuition 2,099.44

Health Fee 45.85

In addition, a fee is assessed for use of dormitories. Meals are provided at cost through a student cooperative.

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, 376-2424; or 199 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108, 376-2572). 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 Forestry 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 of Student Services for application information.

College of Forestry 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 \$1,200 awards annually.

R. M. Brown Scholarship—Sponsored by donations to the College of Forestry. For a Forest Resources or Renewable Resource Science 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 undergraduate students. Six \$300 to \$400 awards annually.

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. Two \$300 awards annually.

Caleb Dorr Scholarships—Sponsored by the Caleb D. Dorr Fund. For the student in each class with the highest grade point average. Four \$300 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. \$300 to \$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. \$100 each.

Forest Products Marketing Scholarship—Sponsored by the Forest Industry Fraternity of Minneapolis and St. Paul. For a deserving and promising Forest Products junior or senior in the marketing specialization. One \$1,000 award 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.

Samuel B. Green Scholarship Medal—Sponsored by the late Mrs. Samuel B. Green in memory of her husband. For the

senior with the highest scholastic 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 on the basis of outstanding academic ability and strong desire to pursue careers in natural resource management. Five 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.

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 \$1,500 award 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 undergraduate students who write the best essays of a popular nature on forestry or conservation subjects. Three awards annually of \$300, \$200, and \$100.

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Paper Science and Engineering Scholarships—Sponsored by Sunds Defibrator, Inc.; Beloit Foundation, Inc.; Blandin Paper Company; H. B. Fuller Company; Minnesota Section, Technical Association of the Pulp and Paper Industry; North Central Division, Paper Industry Management Association; Potlatch Foundation for Higher Education; Nalco Chemical Company; Consolidated Papers Foundation, Inc.; Champion International Corp.; and Paper Science and Engineering Alumni. For Forest Products juniors and seniors in the pulp and paper specialization on the basis of academic performance and professional promise. \$1,200 to \$1,800 each.

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.

K. E. Winsness Scholarship—Sponsored by family and friends of the late professor Winsness. For a junior or senior in the College of Forestry 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 initiate and complete their forestry education. One \$200 award annually.

Lake Itasca Summer Biology Session Scholarships—Available to Fisheries and Wildlife students.

Student Activities

Governance—Students have opportunities to 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 Forestry 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 in 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 Club-Forest Products Research Society, Technical Association of Pulp and Paper Institutes (TAPPI), and Fisheries and Wildlife Club (with an affiliated student chapter of the Wildlife Society). Through these clubs, students hold an annual Foresters Day and a spring picnic, support a scholarship fund by selling Christmas trees, attend events like the Midwestern Foresters Conclave, and produce and market wood identification kits. Xi Sigma Pi Honor Society stages an annual banquet and administers a student speakers bureau. Forestry students also produce one of the few remaining University yearbooks, the *Gopher Peavey*.

Baccalaureate Programs



Baccalaureate Programs

Seven Major Curricula

The College of Forestry offers seven major curricula leading to the bachelor of science (B.S.) degree: (1) Fisheries; (2) Wildlife; (3) Forest Products (with specializations in marketing, production management, paper science and engineering, and wood science and technology); (4) Forest Resources; (5) Renewable Resource Science (with specializations in natural science and social and managerial sciences); (6) Recreation Resource Management; and (7) Urban Forestry. Because the first year of course work 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 assistance from an adviser, 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 curriculum are assigned an adviser in the college's Office of Student Services. All other students are assigned a faculty adviser within their curriculum.

Credit Load—The typical work 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 of Student Services.

Auditing—Students who register for a course as an auditor 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 a course, with the instructor's approval. The extra work is mutually agreed to and conducted independently of class. Contact the Office of Student Services for more information.

Independent Study—Students may register to take regularly offered courses through independent study, without attending class, with the instructor's approval. Contact the Office of Student Services for more information.

Class Attendance—When students willfully miss class, instructors are under no obligation to help them make up work. The following reasons, however, are accepted to 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 of Student Affairs, in University-approved cocurricular activities, and (d) approval of the absence by the department Student Scholastic Standing Committee, which becomes involved only in special emergencies or as an appeal agency.

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

Registration—General registration instructions are contained in the quarterly *Class Schedule*.

Forest Resources and Forest Products juniors and seniors may sign their own quarterly course request form. 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 of Student Services for instructions and forms.

During the first week of the quarter, a course may be added to a student's schedule with the approval of only the adviser (providing the course is open). But after the first week, the approval of both the adviser and the instructor is needed in order to add a course.

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

If a student withdraws from the college at any time, all classes should be officially cancelled. Cancellation within the first six weeks entitles the student to a refund prorated according to the number of classes attended.

Grading—Two grading options, A-B-C-D-N 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 Forestry 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. Required courses must be taken under the A-N option. Prerequisites for required courses and courses in the major must also be taken A-N 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 on how the honor system works, contact the Office of Student Services.

Satisfactory Progress—Students in the College of Forestry 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 GPA after first two quarters in college below 1.90 (freshman) or 2.00 (sophomore, junior, senior) <i>or</i> Any combination of three D and N 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) <i>or</i> Any combination of four D and N grades in three consecutive quarters <i>or</i> Two consecutive quarters of probation

A probation action puts a student on notice 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 Forest Resources and Renewable Resource Science students is not counted as a separate quarter.

Baccalaureate Programs

Itasca grades are included with the fall quarter grades.

Students who are performing poorly academically should contact their adviser as soon as possible to take corrective action. Probation and suspension actions are rarely waived.

To appeal a suspension or probation action, the student must submit a written statement to the chair of the department Student Scholastic Standing Committee explaining the reasons for the appeal and including any supporting documents. The final decision rests with the department head, who will explain the decision on the appeal in a letter to the student.

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 request, by petition, 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 of Student Services for more information.

Graduation Requirements

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

1. Complete a minimum of 192 credits, 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 grade point average of 2.00 or higher with no more than 5 credits of D in required forestry or fisheries and wildlife 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 grade point average 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 grade point average 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 Forestry 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 grade point average 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 of Student Services.

Liberal Education Requirements—The University of Minnesota believes that 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 Forestry requires course work in each of four liberal education categories. The minimum number of credits required in each category and a partial list of courses follow. *Note:* Individual College of Forestry 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 their adviser.

All College of Forestry students must take Rhet 1101, 1104, 1151, 1222, and 3562 (except that Recreation Resource Management majors may substitute 3551 for 3562). Students who pass an English proficiency examination, administered by the Rhetoric Department, may be exempted from Rhet 1101 and/or 1104. 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 Forestry 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
Rhet 1101, 1104, 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 1051, 3091, 5021

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

1. The Physical Universe
Ast 1011, 1021
BioC 1301-1302
Chem 1001-1002, 1003, 1004-1005, 1006

- Geo 1001, 1002, 1111
- Phys 1041, 1042, 1045, 1046, 1271-1281-1291
- Soil 1122, 1262

2. The Biological Universe

- Biol 1009, 1103, 1106
- Bot 1009, 1012
- Ent 1005
- GCB 3022
- Phsl 1002

C. The Individual and Society—8 credits minimum (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 1020, 1030
Anth 1102
Econ 1001-1002, 1004-1005, 3001-3002
FR 1201
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
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
ArtH—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, Renewable Resource Science, Urban Forestry, and Fisheries and Wildlife majors are required to complete a 3½-week

Baccalaureate Programs

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 grade point average of 2.00. Forest Resources, Renewable Resource Science, and Urban Forestry students must have also 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, 5041 and FW 3052. Fisheries students must also complete Chem 1005 with a grade of C or better. The session is also open to students who are not enrolled in the College of Forestry.

It is the responsibility of all transfer students to supply the College of Forestry with transcripts of any course work and an application by July 15 before the start of the Itasca session they wish to attend.

Cloquet Session—Students in Forest Resources and Renewable Resource Science are required to complete the Cloquet Forestry Session in the fall of their senior year. To attend, students must have attained a minimum cumulative grade point average of 2.00 at the end of the preceding quarter and completed the Itasca Forestry Session and FR 1100, 1122, 5100, 5114, 5200 and 5212. In addition, Forest Resources students must have completed CE 3100, FR 3103, 5215, 3232, and FW 3052.

Minnesota-Idaho Student Exchange—College of Forestry students at the University of Minnesota may study timber harvesting in Idaho during their senior year. This opportunity is the result of an exchange agreement with the University of Idaho in which Idaho students take course work at the University of Minnesota. Under the agreement, Minnesota students return from a period of study at Idaho to be awarded their baccalaureate degree from either the department of Forest Products or Forest Resources. Har-

vesting is the central focus of both departments, with Forest Products students studying engineering techniques and Forest Resources students concentrating on managerial and biological areas.

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 bachelor of science in forest products, with a specialization in paper science and engineering, production management, marketing, or wood science and technology. Full-time students who have declared a major in forest products in the College of Forestry and who have a 2.70 grade point average (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 submit a written report on their work assignments and learning experiences to a faculty member. Successful reports are graded "S" (satisfactory) and 1 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) 373-1210.

Fisheries and Wildlife

These curricula offer basic training 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. Undergraduates should recognize that they 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.)

Beginning freshmen and new advanced standing students are admitted with pre-fisheries and wildlife status. Applications should be submitted before July 15 for fall quarter of the following academic year, or two months in advance for winter or spring quarter or the first or second summer term. Pre-fisheries and wildlife status enables students—in close consultation with their faculty adviser—to establish definite goals for their major or, if scholastic performance or interest proves lacking, to seek another curriculum at an early stage.

Pre-Fisheries and Wildlife (Freshman, Sophomore Years)—90 credits

A. Communication, Language, Symbolic Systems—18 credits

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Laboratory (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Math 1142—Short Calculus (5)¹

B. Physical, Biological, and Analytical Sciences—50 credits

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
- Biol 1106—General Zoology (5)
- Biol 5041—Ecology (4)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- FW 1001—Orientation in Fisheries and Wildlife (2)
- FW 3052—Introduction to Fisheries and Wildlife Biology and Management (4)
- Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)
- Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)
- VB 1120—Comparative Vertebrate Morphology (5)

C. The Individual and Society—10 credits²

- AgEc 1020—Principles of Macroeconomics (5)
- Pol 1001—American Government and Politics (5)

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

See suggestions under Liberal Education above.

Elective or major credits—4 credits

Consult adviser.

Fisheries Major (Junior, Senior Years)—102 credits

Itasca Session—6 credits (required of all fisheries students entering the college fall 1986 and after; taken between sophomore and junior years)

- FR 3100—Minnesota Plants (1)
- FW 3400—Fisheries Techniques (5)

Required Core Courses—67-68 credits

- AnSc 3301—Systemic Physiology (6)
- Chem 3100, 3101—Quantitative Analysis and Laboratory (3, 2)

- Chem 3301, 3305—Elementary Organic Chemistry I and Laboratory (4, 2)
- CSci 3102—Introduction to Pascal Programming (4)
- or CSci 3104—Introduction to Programming and Problem Solving (5)
- or an introductory computer science course (4)
- EBB 5136—Ichthyology (4)
- EBB 5601—Limnology (4)
- FW 5451—Ecology of Fish Populations (4)
- FW 5452—Fishery Management in Inland Waters (4)
- FW 5455—Aquaculture (4)
- FW 5459—Environmental Physiology of Fishes (3)
- GCB 3022—Genetics (4)
- Geo 1001—Physical Geology (5)
- Rhet 3562—Writing in Your Profession (4)
- Stat 5021—Statistical Analysis I (5)
- Stat 5022—Statistical Analysis II (5)

Supporting Courses—Select four of the following—18-21 credits

- Bot 5231—Introduction to the Algae (5)
- or Bot 5811—Freshwater Algae (5) (*Itasca*)
- Chem 1006—Principles of Solution Chemistry (4)
- Chem 3302, 3306—Elementary Organic Chemistry II and Laboratory (4, 2)
- EBB 5112—Invertebrate Biology (5)
- EBB 5606—Ecology of Fishes (3)
- or FW 5456—Field Ecology of Fishes (5) (*Itasca*)
- Ent 3175—Introductory Entomology (5)
- or Ent 5020—Field Entomology (5) (*Itasca*)
- FW 5458—Water Quality Management: Ecosystem Approaches (4)
- MicB 3103—General Microbiology (5)

Electives—7-11 credits

Consult adviser to complete the 192 total credits required for graduation.

Wildlife Major (Junior, Senior Years)—102 credits

Itasca Session—6 credits (required of all wildlife students entering the college fall 1986 and after; taken between sophomore and junior years)

- FR 3100—Minnesota Plants (2)
- FW 3201—Field Forest Measurements (1)
- FW 3500—Wildlife Techniques (3)

Required Core Courses—36-37 credits

- AnSc 3301—Systemic Physiology (6)
- EBB 5014—Ecology of Plant Communities (5)
- or EBB 5814—Community Structure and Functioning (5) (*Itasca*)

Two of the following:

- EBB 5114—Vertebrate Biology (4)
- FW 5129—Mammalogy (5)
- EBB 5132—Herpetology (5)
- EBB 5134—Introduction to Ornithology (5)
- EBB 5834—Field Ornithology (5) (*Itasca*)
- FW 5281—Senior Seminar: Wildlife (1)
- FW 5561—Wildlife Ecology, Management: Planning (4)
- FW 5562—Wildlife Ecology, Management: Populations (3)

¹Math 1211-1221-1231 also recommended.

²FR 1201—Conservation of Natural Resources (3) also recommended.

Baccalaureate Programs

- FW 5563—Wildlife Ecology, Management: Habitats (4)
FW 5564—Wildlife Ecology, Management: Field Trip (1)
VPB 5603—Parasites of Wildlife (3)
or VPB 5604—Diseases of Wildlife (3)
- Supporting Courses—27-31 credits**
BioC 1301, 1302, 1303—Elementary Biochemistry I, II, and Laboratory (5,3,2)
or Chem 3301, 3305, 3302, 3306—Elementary Organic Chemistry I and Laboratory, II and Laboratory (4,2,4,2)
- CSci 3102—Introduction to Pascal Programming (4)
or CSci 3104—Introduction to Programming and Problem Solving (5)
or an introductory computer science course (4)
- Geo 1001—Physical Geology (5)
or Soil 1122—Introductory Soil Science (4)
- Rhet 3562—Writing in Your Profession (4)
Stat 5021—Statistical Analysis I (5)
- Electives—28-33 credits**
Consult adviser to complete the 192 total credits required for graduation.

Fisheries and Wildlife Minor

This minor enables majors in the natural resource areas or fields like communications and education to deal with wildlands or water resources in a minor way. 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—20-21 credits**
FW 1001—Orientation in Fisheries and Wildlife (2)
Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Biol 5041—Ecology (4)
- One vertebrate biology course from the following:
EBB 5114—Vertebrate Biology (4)
FW 5129—Mammalogy (5)
EBB 5134—Introductory Ornithology (5)
or EBB 5834—Field Ornithology (5) (*Itasca*)
EBB 5136—Ichthyology (4)
EBB 5606—Ecology of Fishes (5)
or FW 5456—Field Ecology of Fishes (5) (*Itasca*)
VB 1120—Comparative Vertebrate Morphology (5)

- Minor Core Courses—13 credits**
FW 3052—Introduction to Fisheries and Wildlife Biology and Management (4)
FW 5452—Fishery Management in Inland Waters (5)
FW 5563—Wildlife Ecology, Management: Habitats (4)

- Optional Courses—3-4 credits (must choose at least one)**
FW 5451—Ecology of Fish Populations (4)
or FW 5459—Environmental Physiology of Fishes (3)
or FW 5455—Aquaculture (4)
or FW 5561—Wildlife Ecology, Management: Planning (4)
or FW 5562—Wildlife Ecology, Management: Populations (3)

Forest Products

This curriculum is for students interested in careers in the development, production, marketing, and utilization of the thousands of products that flow from forests—from plywood and furniture to biomass for energy. 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 sales, distribution, and market development of forest products. The technical emphasis is on the physical-mechanical nature of wood-based building materials including lumber, plywood, fiberboard, particleboard, and newer composite products. In addition, course work focuses on marketing principles and analysis, management science, computer applications, and economics. Career opportunities include purchasing and selling all types of forest products at the wholesale and retail levels, technical sales, product promotion, and specialized marketing research.

- Freshman Year—39 required credits**
AgEc 1020—Principles of Macroeconomics (5)
AgEc 1030—Principles of Microeconomics (4)
Biol 1009—General Biology (5)
Chem 1001—Chemical Principles and Covalent Systems (5)
Chem 1002—Chemical Principles and Covalent Systems (5)
Math 1142—Short Calculus (5)
Psy 1001—General Psychology (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Laboratory (1)
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 Lab (1)
 Phys 1046—Introductory Physics Lab (1)
 Jour 1001—Introduction to Mass Communication (2)
 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—40 required credits
 BLaw 3058—Introduction to Law, and the Law of
 Contracts and Agency (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)
 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—36 required credits
 ForP 5304—Wood Drying and Preservation Processes
 (4)
 ForP 5306—Analysis of Production Systems (3)
 ForP 5307—Wood-Base Panel Technology (4)
 ForP 5331—Senior Seminar (2)¹
 ForP 5355—Mechanics and Structural Design With
 Wood Products (4)
 ForP 5356—Advanced Forest Products Marketing (3)
 BME 5260—Professional Sales (3)
 BFin 3000—Finance Fundamentals (4)
 Mktg 3030—Sales and Distribution Management (4)
 Psy 5751—Psychology of Advertising (4)
 Rhet 3562—Writing in Your Profession (4)¹
 Electives and liberal education requirements

Directed Electives—at least two courses
 Acct 3160—Financial Statement Analysis (4)
 Jour 5549—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)
 Tran 3054—Fundamentals of Transportation (4)
 Tran 3064—Business Logistics (5)

Total Graduation Requirements—192 credits
 Required courses listed above (167-168 credits),
 liberal education requirements in category D (8
 credits), and electives (16-17 credits).

Production Management—This spe-
 cialization is for students interested in
 production management careers in indus-

tries that manufacture lumber, plywood,
 particleboard, furniture, and other wood
 products. In addition to a basic wood sci-
 ence background, students gain knowl-
 edge in industrial engineering, labor
 management, and economics.

Freshman Year—34 required credits
 AgEc 1020—Principles of Macroeconomics (5)
 AgEc 1030—Principles of Microeconomics (4)
 Biol 1009—General Biology (5)
 Chem 1004—General Principles of Chemistry (5)
 Chem 1005—General Principles of Chemistry (5)
 Math 1142—Short Calculus (5)
 Rhet 1101—Writing to Inform and Persuade (4)
 Rhet 1104—Library Laboratory (1)
 Electives and liberal education requirements

Sophomore Year—42 required credits
 BioC 1301—Elementary Biochemistry (5)
 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 Lab (1)
 Phys 1046—Introductory Physics Lab (1)
 Psy 1001—General 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—41 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 5355—Mechanics and Structural Design with
 Wood Products (4)
 IEOR 5000—Introduction to Industrial Engineering
 Analysis (4)
 IEOR 5030—Quality Control and Reliability (4)
 IEOR 5040—Introduction to Operations Research (4)
 IR 3002—Industrial Relations Systems: Labor
 Markets and the Management of Human
 Resources (4)
 Electives and liberal education requirements

Senior Year—40 required credits
 ForP 5304—Wood Drying and Preservation Processes
 (4)

¹Two credits of Rhet 3562 are to be taken with ForP
 5306 and 2 credits with ForP 5331, for a total of 4 Rhet
 3562 credits. Students taking ForP 5306 and ForP
 5331 in the same quarter should register for Rhet
 3562Y (4 credits). Students taking ForP 5306 and
 ForP 5331 in different quarters should register for
 Rhet 3562X (2 credits) concurrently with each ForP
 course.

Baccalaureate Programs

ForP 5305—Pulp and Paper Technology (4)
ForP 5306—Analysis of Production Systems (3)¹
ForP 5307—Wood-Base Panel Technology (4)
ForP 5331—Senior Seminar (2)¹
IEOR 5010—Introduction to Work Analysis (4)
IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
IEOR 5311—Management for Engineers (3)
IEOR 5361—Inventory and Production Control (4)
IR 3007—Collective Bargaining Negotiations and Modern Labor Relations (4)
Rhet 3562—Writing in Your Profession (4)¹
Electives and liberal education requirements

Total Graduation Requirements—192 credits
Required courses listed above (157 credits), liberal education requirements in category D (8 credits), and electives (27 credits).

Paper Science and Engineering—This specialization provides in-depth training in mathematics, physics, chemistry, and wood science and technology. It also includes specialized pulp and paper and related engineering courses on the technology of wood pulp production and the manufacture of paper and other fiber products. Graduates find careers in process engineering, technical services, industrial sales, and research.

Freshman Year—39 required credits
AgEc 1020—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)
Math 1211—Calculus I (5)
Math 1221—Calculus II (5)
Math 1231—Calculus III (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Laboratory (1)
Electives and liberal education requirements

Sophomore Year—42 required credits
Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Lab I (2)
Chem 3306—Elementary Organic Chemistry Lab II (2)

ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
Math 3221—Introduction to Linear Algebra and Linear Differential Equations (5)

Phys 1271—General Physics (4)
Phys 1275—General Physics Lab (1)
Phys 1281—General Physics (4)
Phys 1285—General Physics Lab (1)
Phys 1291—General Physics (4)
Phys 1295—General Physics Lab (1)
Rhet 1151—Writing in Your Major (4)
Electives and liberal education requirements

Junior Year—39 required credits
CE 3400—Fluid Mechanics (4)

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 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)
ME 3301—Thermodynamics (4)
Rhet 1222—Public Speaking (4)
Stat 5021—Statistical Analysis I (5)
Electives and liberal education requirements

Senior Year—37 required credits
AgEn 5070—Automatic Control and Instrumentation (4)

Chem 5520—Elementary Physical Chemistry (3)
ForP 5306—Analysis of Production Systems (3)¹
ForP 5312—Pulp and Paper Process Calculations (4)
ForP 5313—Pulp and Paper Process Operations (5)
ForP 5315—Paper Engineering Laboratory (2)
ForP 5316—Coated Product Development (2)
ForP 5331—Senior Seminar (2)¹
ForP 5353—Wood Chemistry II (2)
ForP 5359—Surface and Colloid Chemistry of Papermaking (3)
ForP 5361—Adhesion and Adhesives (3)
Rhet 3562—Writing in Your Profession (4)¹
Electives and liberal education requirements

Suggested Electives

CE 3500—Introduction to Environmental Engineering Problems and Analysis (4)
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)
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 Lab I (2)
ME 3702—Basic Measurements Lab II (2)
ME 5283—Industrial Instrumentation and Automatic Control (4)

Total Graduation Requirements—192 credits
Required courses listed above (157 credits), liberal education requirements in categories C and D (11 credits), and electives (24 credits).

Wood Science and Technology—This specialization is designed for students who want broad and in-depth education in

¹ Two credits of Rhet 3562 are to be taken with ForP 5306 and 2 credits with ForP 5331, for a total of 4 Rhet 3562 credits. Students taking ForP 5306 and ForP 5331 in the same quarter should register for Rhet 3562Y (4 credits). Students taking ForP 5306 and ForP 5331 in different quarters should register for Rhet 3562X (2 credits) concurrently with each ForP course.

forest products. It provides a strong background in mathematics, the biological and physical sciences, the fundamental properties of wood, and the technology of wood products manufacturing.

Freshman Year—44 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)
- Math 1211—Calculus I (5)
- Math 1221—Calculus II (5)
- Math 1231—Calculus III (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Laboratory (1)
- 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 Lab I (2)
- Chem 3306—Elementary Organic Chemistry Lab 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 Lab (1)
- Phys 1281—General Physics (4)
- Phys 1285—General Physics Lab (1)
- Phys 1291—General Physics (4)
- Phys 1295—General Physics Lab (1)
- Rhet 1151—Writing in Your Major (4)
- Electives and liberal education requirements

Junior Year—40 required credits

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- Chem 3100—Quantitative Analysis Lecture (3)
- Chem 3101—Quantitative Analysis Lab (2)
- Chem 5520—Elementary Physical Chemistry (3)
- ForP 3300—Wood Industry Tours (2)
- ForP 5300—Wood-Fluid Relationships (3)
- ForP 5301—Analysis of Production Systems (3)
- ForP 5302—Wood Chemistry I (3)
- ForP 5303—Wood Deterioration (3)
- Rhet 1222—Public Speaking (4)
- Stat 5021—Statistical Analysis I (5)
- Electives and liberal education requirements

Senior Year—34 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)¹
- ForP 5307—Wood-Base Panel Technology (4)
- ForP 5331—Senior Seminar (2)¹
- ForP 5353—Wood Chemistry II (2)
- ForP 5355—Mechanics and Structural Design With Wood Products (4)

- ForP 5361—Adhesion and Adhesives (3)
- Rhet 3562—Writing in Your Profession (4)¹
- Electives and liberal education requirements

Total Graduation Requirements—192 credits
Required courses listed above (164 credits), liberal education requirements in categories C and D (11 credits), and electives (17 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 required credits

- 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)
- Geo 1001—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)

¹ Two credits of Rhet 3562 are to be taken with ForP 5306 and 2 credits with ForP 5331, for a total of 4 Rhet 3562 credits. Students taking ForP 5306 and ForP 5331 in the same quarter should register for Rhet 3562Y (4 credits). Students taking ForP 5306 and ForP 5331 in different quarters should register for Rhet 3562X (2 credits) concurrently with each ForP course.

Baccalaureate Programs

Phys 1001—The Physical World (4)
Phys 1005—Physics Laboratory (1)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Laboratory (1)
Electives and liberal education requirements

Sophomore Year—34 required credits
AgEc 1020—Principles of Macroeconomics (5)
AgEc 1030—Principles of Microeconomics (4)
CE 3100—Introduction to Surveying and Mapping (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 1301—Wood as a Raw Material (4)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Stat 3081—Experimental Techniques and Statistical Inference (5)
or Stat 5021—Statistical Analysis I (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—42 required credits
FR 1100—Dendrology (4)
FR 1122—Introductory Soil Science (4)
FR 3103—Meteorology and Climatology for 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 Biology and Management (4)
Electives and liberal education requirements

Senior Year—28 required credits
Fall Quarter—Cloquet Session
FR 5101—Field Silviculture (4)
FR 5115—Forest Hydrology, Field Applications (2)
FR 5126—Field 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 Management 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 (159 credits), liberal education requirements in categories C and D (11 credits), and electives and credits to satisfy area of emphasis (20 credits).

Areas of Emphasis

For an explanation of abbreviations, see *Course Numbering and Symbols at the beginning of the Course Descriptions section*.

Forest Hydrology—This interdisciplinary emphasis is primarily concerned with developing 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, 301f Green Hall (612/376-4883) or Dr. James A. Perry, 301c Green Hall (612/373-0846).

Required Courses

—26 credits

Math 1211, 1221f,w,s—Calculus I, II (10)
FR 5153s—Advanced Forest Hydrology (4)
CE 5401f,w—Water Resources Engineering (4)
CE 5405w,s—Hydrology, Hydrologic Design (4)
FR 5458s—Water Quality Management: Ecosystem Approaches (4)

Recommended Electives—at least four courses
FR 5231w—Range Management (3)
FR 5262w—Remote Sensing of Natural Resources (4)
FR 3115s—Tree Physiology Laboratory (3)
FR 5264s—Quantitative Techniques in Forest Management (3)

AgEn 5540f—Erosion Control, Watershed Engineering (4)

AgEn 5550w—Drainage and Irrigation Engineering (4)

CE 3400f—Fluid Mechanics (4)

CE 3500f—Introduction to Environmental Engineering Problems and Analysis (4)

CE 5402w—Computational Hydraulics (4)

CE 5410f—Open Channel Hydraulics (4)

CE 5425w—Groundwater Mechanics (4)

CE 5505w—Water Quality Engineering (4)

CE 5506w—Environmental Water Chemistry (4)

CE 5420s—Introduction to Water Resources Management (4)

Geo 5251f—Geomorphology (Cr ar)

Geo 5611s—Groundwater Geology (3)

Soil 5232f—Soil Physics (5)

Soil 5310f—Soil Chemistry (4)

Soil 5240w—Microclimatology (5)

Soil 5710s—Advanced Forest Soils (Cr ar)

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, S-325 Hodson Hall (612/373-1443).

Required Courses—23-24 credits

- FR 1122w—Introductory Soil Science (4)
- Soil 3416w—Soil Fertility (5)
- Soil 3520s—Soil Morphology, Classification, and Genesis (4)
- Soil 5710s—Advanced Forest Soils (3)
- Soil 3210w—Soil Physical Properties (4)
- Soil elective (3-4)

Recommended Electives—at least two courses (including 3 Soil credits)

- FR 3104f—Forest Ecology (3)
- FR 3115s—Tree Physiology Lab (1)
- FR 5102s—Regional Silviculture (3)
- FR 5153s—Advanced Forest Hydrology (4)
- FR 5231w—Range Management (3)
- FR 5260w—Forest Administration (3)
- FR 5262w—Remote Sensing of Natural Resources (4)
- FR 5264s—Quantitative Techniques in Forest Management (3)
- Ent 5050s—Forest Entomology (4)
- Geo 5251f—Geomorphology (Cr ar)
- Geo 5261f—Glacial Geology (Cr ar)
- Soil 3610f—Soil Biology (4)
- Soil 3xxx f, w, s—Seminars on Special Topics (1 each)
- Soil 5230w—Soil-plant Water Relations (3)
- Soil 5232w—Soil Physics (5)
- Soil 5240w—Microclimatology (5)
- Soil 5515f—Soil Development, Classification and Geography (4)
- Soil 5540s—Soil Resources and Environmental Relationships (2)
- Soil 5550w—Peatlands (3)
- Soil 5560s—Uses and Interpretation of Soil Survey Information (3)
- PlPa 5050s—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 in managing 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, 110i Green Hall (612/373-0851); Dr. Hans M. Gregersen, 301d Green Hall (612/373-1754); Dr. Frank D. Irving or Dr. Dietmar W. Rose, 110b Green Hall (612/373-1319).

Required Courses—13 credits

- Mgmt 3001f, s—Fundamentals of Management (4)
- Acct 1024f, w, s—Principles of Financial Accounting I (3)
- Acct 1025f, w, s—Principles of Financial Accounting II (3)
- FR 5240w—Natural Resource Policy and Administration (3)
- FR 5260w—Administrative Processes for Natural Resource Managers (3)
- or FR 5264s—Quantitative Techniques in Forest Management (3)

Recommended Electives—31 credits

- Acct 3001f, s—Managerial Accounting (4)
- BLaw 3058f, w, s—Introduction to Law, the Law of Contracts (4)
- BGS 3002f, w, s—Business and Society (4)
- FR 5241s—Legal and Political Processes in Forestry (3)
- IR 3010f, w, s—Human Relations and Applied Organization Theory (4)
- Mgmt 3002f, w, s—Psychology in Management (4)
- MIS 5300f—Management Information Systems (4)
- PA 5515f—Introduction to Planning (4)

Industrial Forest Management—This emphasis is designed for students who wish to gain a more complete understanding of the management of industrial forests. Planning, decision-making, and project implementation activities are stressed. For more information, contact Dr. Dietmar W. Rose, 101b Green Hall (612/373-1319).

Required Courses—27-28 credits

- FP 3303w—Forest Products Marketing (3)
- FR 3300s—Wood Industry Tours (2)
- or FP 5306w—Manufacturing Processes (3)
- FR 5253s—Forest Biometry (3) *(offered alt even years)*
- or FR 5255s—Forest Resources Survey Design (3) *(offered alt odd years)*
- FR 5260w—Administration Processes for Natural Resource Managers (3)
- FR 5264s—Quantitative Techniques in Forest Management (3)
- IEOR 5050f—Engineering Economics Analysis (4)
- Math 1221f, w, s—Calculus II (5)¹
- Math 1231f, w, s—Calculus III (5)

Recommended Electives

- FR 5241s—Legal and Political Processes in Forestry (3)
- IEOR 5000f, w, s—Introduction to Industrial Engineering Analysis (4)
- IEOR 5020f, w, s—Engineering Cost Accounting, Analysis and Control (4)

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

Baccalaureate Programs

IEOR 5040f,w,s—Introduction to Operations Research (4)

IEOR 5441w—Operations Research II (4)

MIS 5300f—Survey of Computers and Management Information Systems (4)

CSci 3101f,w,s—A Fortran Introduction to Computer Programming (4)

Stat 5021f,w,s—Statistical Analysis I (5)

Stat 5022f,w,s—Statistical Analysis II (5)

Resource Measurements and Information Systems—This emphasis is for students with mathematics and computer skills who are interested in forest measurement and information systems. Focus is on such subjects as mensuration, sampling, mathematical modelling, statistics, computer science, remote sensing, and data base management. For more information, contact Dr. Alan R. Ek, 110d Green Hall (612/373-0840), or Dr. Thomas E. Burk, 209a Green Hall (612/373-0747).

Required Courses—27 credits

FR 5253s—Forest Biometry (3; prereq FR 5212, Stat 5022, or #; offered alt even yrs)

or FR 5255s—Forest Resource Survey Design (3; prereq FR 5212, Stat 5022, or #; offered alt even yrs)

Stat 5021f,w,s—Statistical Analysis I (5; prereq college algebra)

Stat 5022f,w,s—Statistical Analysis II (5; prereq Stat 5021 or #)

Math 1221f,w,s—Calculus II (5; prereq Math 1211 with C or better)

Math 1231f,w,s—Calculus III (5; prereq Math 1221 with C or better)

CSci 3101f,w,s—A FORTRAN Introduction to Computer Programming (4; prereq Math 1111 or 1201)
or other FORTRAN (4)

Recommended Electives—at least two courses

FR 5264s—Quantitative Techniques in Forest Management (3; prereq FR 5212, 5226, or #)
or IEOR 5040f,w,s—Introduction to Operations Resources (4; prereq Math 1231)

FR 5262w—Remote Sensing of Natural Resources (4; prereq FR 5200 or #)

Stat 5302f,s—Applied Regression Analysis (4; prereq Stat 5022 or #)

Stat 5301f,s—Designing Experiments (4; prereq Stat 5022 or #)

Forest Harvesting—This emphasis is for students interested in timber harvesting and its impact on other land management considerations. The course work 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 Scott Reed, Cloquet Forestry Center, Cloquet, MN 55720 (218/879-4528).

Junior Year

Fall Quarter (Minnesota)—13 credits

FR 3104—Forest Ecology (3)

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

FW 3052—Introduction to Fish and Wildlife Biology (4)

CE 3100—Introduction to Surveying and Mapping (4)

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 Resource 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 433—Forest Tractor Systems Analysis (3

sem/4.5 qtr cr)

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

Fall Semester (Idaho)—8 semester credits

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

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

Geol E 435—Intro Geol. Engr. (3 sem/4.5 qtr cr)

Electives

Recommended Electives (Idaho)

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

For Pr 534—Advanced Techniques of Timber

Harvesting (3 sem/4.5 qtr cr)

For 463—Watershed Analysis and Planning (3 sem/4.5 qtr cr)

For 471—Forest Land Resources Planning Appl. (2 sem/3 qtr cr)

For 478—Western Forestry Practices (0)

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

For 470—Land Use Planning (2 sem/3 qtr cr)

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

Recommended Electives (Minnesota)

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

Soil 5710—Advanced Forest Soils (cr ar)

FR 5153—Advanced Forest Hydrology (4)

FR 5105—Intensive Silviculture (3)

Silviculture—This emphasis relates the biological sciences, such as silviculture, ecology, and physiology, to forest land use and management decisions. For more information, contact Dr. Alvin A. Alm, Cloquet Forestry Center, Cloquet, MN 55720 (218/879-4528).

Required Courses—18 credits

- FR 5120w—Introductory Tree Physiology and Genetics (4)
- FR 5140s—Application of Silviculture in North American Forest Types (3)
- Soil 5710s—Advanced Forest Soils (3)
- Ent 5050w—Forest Entomology (4)
- PIPa 5050s—Forest Pathology (4)

Recommended Electives—8 credits minimum

- At least three courses below or three from other departments with adviser's consent:*
- FR 3102s—Southern Forest Resources Tour (1)
 - FR 5106w—Senior Silviculture Seminar (2-3)
 - FR 5152w—Forest Genetics (3)
 - FR 5153s—Advanced Forest Hydrology (4)
 - FR 5262w—Remote Sensing of Natural Resources (4)
 - FR 5700f,w,s—Colloquium in Forest Biology (1-2)

Forest Resources Minor

The purpose of this minor is to enable students in natural resources or related areas to develop a solid understanding of forest resource dynamics, management, and the importance of forest resources to our society. The minor incorporates fundamental science background plus course work 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—12-16 credits

- FR 1100—Dendrology (4)¹
- FR 1200—Introduction to Forest Resources (3)
 - or FR 1202—Conservation of Natural Resources (3)
 - or FR 1201—Farm and Small Woodlot Forestry (3)
 - or FR 1203—Introduction to Minnesota's Natural Resources (3)
 - or FR 5406—Forestry Workshop for Teachers (5)
- FR 3104—Forest Ecology (3)¹
- or Biol 5041—Ecology (4)
- FR 5100—Silviculture I (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 Resources Tour (1)

- FR 3232—Management of Recreational Lands (3)
- FR 3250 and
- Fr 5250—Role of Renewable Natural Resources in Developing Countries (1)
- 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—Legal and Political Processes in Forestry (3)
- FR 5248—Harvesting and Engineering (3) (*Cloquet*)
- FR 5253—Forest Biometry (3)
- FR 5255—Forest Resources Survey Design (3)
- FR 5257—Recreation Land Policy (3)
- FR 5259—Analysis of Outdoor Recreation Behavior (3)
- FR 5260—Administrative Processes for Natural Resource Managers (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 5050—Forest Entomology (4)
- FR 1122—Introductory Soil Science (4)
- FR 3103—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)
- PIPa 5050—Forest Pathology (4)

Renewable Resource Science

This curriculum provides an individualized education in the natural, social, and

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

managerial sciences relative to forest resources. Designed for students with a demonstrated potential for academic excellence, it is good preparation for graduate study and subsequent employment in forestry research, teaching, or related fields. Graduates may pursue forest management or similar careers without advanced degree work, but may not be qualified for some professional forestry positions.

Renewable Resource Science students are expected to maintain a minimum grade point average of 3.00. Specializations in natural science and in social and managerial sciences are offered:

NATURAL SCIENCE

Freshman Year—44 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)
- Math 1211—Calculus I (5)
- Math 1221—Calculus II (5)
- Math 1231—Calculus III (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Laboratory (1)
- Electives and liberal education requirements

Sophomore Year—41 required credits

- AgEc 1020—Principles of Macroeconomics (5)
- Chem 3301—Elementary Organic Chemistry I (4)
- Chem 3305—Elementary Organic Chemistry Lab I (2)
- CSci 3101—A FORTRAN Introduction to Computer Programming (4)

- ForP 1301—Wood as a Raw Material (4)
- Phys 1041—Introductory Physics (4)
- Phys 1042—Introductory Physics (4)
- Phys 1045—Introductory Physics Laboratory (1)
- Rhet 1222—Public Speaking (4)
- 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—28 required credits

- FR 1100—Dendrology (4)
- FR 5100—Silviculture (3)
- FR 5212—Natural Resources Inventory (3)
- Stat 5021—Statistical Analysis I (5)
- Electives and liberal education requirements

Senior Year—43-45 required credits

- Fall Quarter—Cloquet Session*
- FR 5101—Field Silviculture (4)
- FR 5115—Forest Hydrology, Field Applications (2)

- FR 5126—Field Forest Soils (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)
- Rhet 3562—Writing in Your Profession (4)
- Electives and liberal education requirements

Total Graduation Requirements—192 credits

Required courses listed above (166-172 credits), liberal education requirements in categories C and D (11 credits), and electives (9-15 credits).

SOCIAL AND MANAGERIAL SCIENCES

Freshman Year—30 required credits

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
- Math 1211—Calculus I (5)
- Math 1221—Calculus II (5)
- Math 1231—Calculus III (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Laboratory (1)
- Electives and liberal education requirements

Sophomore Year—29 required credits

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- Biol 5041—Ecology (4)
- CSci 3101—A FORTRAN Introduction to Computer Programming (4)

- ForP 1301—Wood as a Raw Material (4)

- FR 1100—Dendrology (4)
- Rhet 1222—Public Speaking (4)
- 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—21 required credits

- FR 5100—Silviculture (3)
- FR 5212—Natural Resources Inventory (3)
- Stat 5021—Statistical Analysis I (5)
- Stat 5022—Statistical Analysis II (5)
- Electives and liberal education requirements

Senior Year—15 required credits

- FR 5226—Forest Economics and Planning (5)
- FR 3232—Management of Recreational Lands (3)
- Rhet 3562—Writing in Your Profession (4)
- Electives and liberal education requirements

Total Graduation Requirements—192 credits

Required courses listed above (140-145 credits), liberal education requirements in categories C and D (10 credits), and electives (37-42 credits).

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—47-51 required credits

- 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 1201—Conservation of Natural Resources (3)
 - Geo 1001—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)
 - Rhet 1104—Library Laboratory (1)
 - FR 1122—Introductory Soil Science (4)
- Electives and liberal education requirements
- Sophomore Year**—51-52 required credits
- AgEc 1020—Principles of Macroeconomics (5)
 - AgEc 1030—Principles of Microeconomics (4)
 - Biol 5041—Ecology (4)
 - FR 1100—Dendrology (4)
 - LA 1024—Landscape Theory (4)
 - 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 1031—Selected Problems in American Public Policy (4)
 - or Pol 1001 American Government and Politics (5)
 - Psy 1001—General 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**—37-38 required credits
- AgEc 3610—Community Resource Development (4)
 - or AgEc 5620—Regional Economic Analysis (4)
 - AgET 3410—Hydrology, Water Control (4)
 - or FR 5114—Forest Hydrology (3)
 - FR 3232—Management of Recreational Lands (3)
 - FW 3052—Introduction to Fisheries and Wildlife Biology and Management (4)
 - Geog 3511—Introduction to Cartography (5)
 - Rec 3500—Park and Recreation Administration (5)
 - or Rec 3530—Recreation, 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 3081—Experimental Techniques and Statistical Inference (5)
 - or Stat 5021—Statistical Analysis I (5)
 - or Soc 3801—Sociological Methods I: Descriptive Statistics (5)
- Electives and liberal education requirements.
- Senior Year**—27-28 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)
 - FR 5270—Interdisciplinary Seminar II (4)
 - Soc 5401—Social Organizations (5)
 - or Soc 5651—Rural Social Institutions (4)
 - or Jour 5501—Communication and Public Opinion I (4)
- Liberal education requirements
- Recommended electives:
- Hort 1021—Plant Materials I (4)
 - or Hort 1022—Plant Materials II (4)
 - Bot 1009—Minnesota Plant Life (4)
 - Rhet 5170—Managerial Communications (4)
 - AgEc 1250—Principles of Accounting (5)*
 - CSci 3101—A FORTRAN Introduction to Computer Programming (4)*
 - or CSci 3104 Introduction to Pascal Programming (4)
 - or AgET 3030—Introduction to Problem Solving With Computers (4)
 - or other computer course
 - BLaw 3058—Introduction to Law and the Law of Contracts and Agency (4)*
 - Mgmt 3001—Fundamentals of Management (4)*
 - Mgmt 3002—Psychology in Management (4)
 - Pol 1001—American Government, Politics (5)
 - Rec 5250—Financing Leisure Services (3)*
 - Soc 1651—Rural Sociology (4)
 - FR 5231—Range Management (3)*
 - FR 1101—Introduction to Air, Water Quality (4)

*Required for Recreation Management option.

Baccalaureate Programs

Total Graduation Requirements—192 credits
Required courses listed above (162-169 credits), liberal education requirements (8 credits), and electives (15-22 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).

Recreation Management

Approved Internship proposal (5)
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)
Starred recommended electives under Senior Year above (23)

Law Enforcement

Approved internship proposal (5)
or FR 5269, 5270 (4,4)
Rec 5250—Financing Leisure Services (3)
or FR 5257—Recreation Land Policy (3)
or FR 5259—Analysis of Outdoor Recreation Behavior (3)
GC 3211—Statutory Definitions of Law: Minnesota Criminal Code (4)
GC 3212—Criminal Procedure (4)
GC 3614—Psychology of Crisis Intervention (4)
Soc 3101—Introduction to American Criminal Justice (4)
Soc 5102—Criminology (4)
Soc 5125—Policing in American Society (4)
Soc 5141—Juvenile Delinquency (4)
Soc 5104—Community-Based Corrections (4)
Soc 5147—Sociology of Mental Illness and Health (4)
or Soc 5148—Criminal Psychopathology (4)

Federal Forestry (minimum Civil Service qualifications)

FR 3100—Minnesota Plants (2) (*Itasca*)
FR 1301—Field Forest Ecology (3) (*Itasca*)
FR 3201—Field Forest Measurements (1) (*Itasca*)
FR 5212—Natural Resource Inventory (3)
FR 5221w—Forest Economics and Planning (5)
FR 5226—Forest Economics and Planning (5)
PIPa 5050—Forest Pathology (4)
FR 5114—Forest Hydrology (3)
FR 5215—Forest Fire Management (2)

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

Freshman Year—34-38 required credits

Biol 1009—General Biology (5)
Biol 1103—General Botany (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)
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 1104—Library Laboratory (1)
Rhet 1222—Public Speaking (4)
Electives and liberal education requirements

Sophomore Year—32-34 required credits

AgEc 1020—Principles of Macroeconomics (5)
AgEc 1250—Principles of Accounting (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)
Hort 1021—Woody Plant Materials (5)
FR 1122—Introductory Soil Science (4)
Stat 3081—Experimental Techniques and Statistical Inference (5)
or Stat 5021—Statistical Analysis I (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—34 required credits

ForP 1301—Wood as a Raw Material (4)
FR 1100—Dendrology (4)
FR 3103—Meteorology and Climatology for Resource Managers (2)
FR 3104—Forest Ecology (3)
FR 5100—Silviculture (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (3)
PIPa 5050—Forest Pathology (4)
Rhet 1151—Writing in Your Major (4)
Rhet 3562—Writing in Your Profession (4)

Senior Year—45 required credits

- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (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)
- Ent 5050—Forest Entomology (4)
- FR 5226—Forest Economics and Planning (5)
- FR 5233—Principles of Outdoor Recreation Planning and Design (4)
- FR 5260—Administrative Processes for Natural Resource Managers (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)
- IR 3010—Human Relations, Applied Organization Theory (4)
 or IR 3002—Industrial Relations Systems: Labor Markets, the Management of Human Resources (4)
 or Jour 5549—Public Relations (4)
- PA 5231—Strategy, Tactics in Project Planning (4)
- Liberal education requirements
- Recommended electives (19-21)—must choose four starred courses:
- Ent 5210—Integrated Management (4)
- FW 3052—Introduction to Fisheries and Wildlife Biology and Management (4)*
- FP 1303—Wood Structure and Identification (2)
- FR 3115—Forest and Shade Tree Biology Laboratory (1)
- FR 3232—Management of Recreational Lands (3)*
- FR 5114—Forest Hydrology (3)*
- Hort 1100—Biology of Horticultural Production (4)*
- Hort 1036—Plant Propagation (4)*
- Hort 3026—Residential Landscape Design (4)
- Hort 3072—Turf Management (4)
- Hort 3074—Landscape Management and Horticultural Practices (4)
- LA 1024—Landscape Theory (4)*
- LA 1031—Introduction to Landscape Architecture (4)
- Mgmt 3001—Fundamentals of Management (4)
- Pol 1027—Urban Politics (4)
- Pol 3331—Minnesota Government and Politics (4)

Total Graduation Requirements—192 credits
 Required courses listed above (155 credits), liberal education requirements in categories D and C (11 credits), and electives (19-21 credits).

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 the equivalent course listed after this symbol has been taken for credit.

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

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

△ 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.

f,w,s,su Fall, winter, spring, summer (follows the course number).

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.

Fisheries and Wildlife (FW)

1001. ORIENTATION IN FISHERIES AND WILDLIFE. (2 cr; S-N only)

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

1002. WILDLIFE FOR NON-MAJORS: ECOLOGY, VALUES AND HUMAN IMPACT. (3 cr)

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

3052. INTRODUCTION TO FISHERIES AND WILDLIFE BIOLOGY AND MANAGEMENT.

(4 cr; prereq Biol 5041; 3 lect, 1 demonstration-discussion session per wk) Introduction to fishery and wildlife population ecology; environmental relationships of fish and wildlife populations and habitats; management and research methods; fishery and wildlife agency administration.

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

3400. **FISHERIES TECHNIQUES.** (5 cr; prereq Biol 5041, Chem 1005 and FW 3052; at Itasca) Field experience in gathering data on fish populations and their habitats; data analysis including computer applications and written reports.

3500. **WILDLIFE TECHNIQUES.** (3 cr; prereq Biol 5041 and FW 3052; at Itasca) Field experience in gathering data on wildlife populations and their habitats; data analysis including computer applications and written reports.

5000. **PROFESSIONAL EXPERIENCE PROGRAM.** (4 cr; prereq #; S-N only; free elective for FW undergrads; not for grad cr) Professional experience in fish and wildlife firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5103. **BASIC FISHERY BIOLOGY.** (Cr ar; prereq #) Academic opportunity to enhance biological background in fisheries biology.

5106. **BASIC WILDLIFE BIOLOGY.** (Cr ar; prereq #) Academic opportunity to enhance biological background in wildlife biology.

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.

5281. **SENIOR SEMINAR: WILDLIFE.** (1 cr) Discussion and presentation of papers in wildlife and related subjects.

5393. **SPECIAL PROBLEMS IN FISHERY BIOLOGY.** (Cr ar; prereq #) Individual field, library, and laboratory research in various lines of fishery biology.

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

Individual field, library, and laboratory research in various areas of wildlife biology.

5451. ECOLOGY OF FISH POPULATIONS. (4 cr; prereq Biol 5041 or equiv, EBB/Geo 5601, EBB 5136, Stat 5021 or equiv or #)

Conceptual models of exploited fish populations; description of population characteristics; computer-assisted estimation of population parameters; influence of exploitation on population structure; yield models; relationships between parental stock, recruitment and yield; influence of abiotic factors on year-class formation.

5452. FISHERY MANAGEMENT IN INLAND WATERS. (4 cr; prereq 5041 or #)

Fundamental concepts and applications of fisheries management; pond and reservoir fisheries; lake and stream investigations, rehabilitation; lake fisheries management; warm-water and trout stream management.

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.

5456. FIELD ECOLOGY OF FISHES. (5 cr; prereq introductory course in ecology; offered at Itasca)

Ecological studies, observation, and identification of fishes in their natural habitat including life histories, reproduction, behavior, food habits, interrelationships with other fishes, and general habitat requirements. Collection methods in streams and lakes.

5458. WATER QUALITY MANAGEMENT: ECOSYSTEM APPROACHES. (4 cr, §FR 5458; prereq Chem 1005, 3101 or #)

Anthropogenic influences on aquatic ecosystems. Influences include forest management, point and non-point pollution, and acid rain.

5459. ENVIRONMENTAL PHYSIOLOGY OF FISHES. (3 cr; prereq Biol 5041 and EBB 5136 or equiv)

Examination of environmental factors such as temperature, oxygen, salinity, toxic substances and food ration; effects on fish physiology.

5561. WILDLIFE ECOLOGY, MANAGEMENT: PLANNING POLICY AND ADMINISTRATION. (4 cr; prereq 3052, sr fisheries or wildlife major or #)

Quantitative management methods such as linear programming, other decision-making methods. Extensive use of computer exercises. Policy and structure of wildlife management agencies covered by reading assignments.

5562. WILDLIFE ECOLOGY, MANAGEMENT: POPULATIONS. (3 cr; prereq FW jr or sr or #)

Characteristics of wildlife populations relevant to management, including natality, recruitment, and mortality rates, density and behavior.

5563. WILDLIFE ECOLOGY, MANAGEMENT: HABITATS. (4 cr; prereq wildlife or biol major, FW 3052, grad in related field, or #)

Management of habitats for birds and mammals as developed from their environmental interactions and requirements. Emphasis on regional settings and practices. Two all-day and two weekend field trips.

5564. WILDLIFE ECOLOGY, MANAGEMENT: FIELD TRIP. (1 cr; prereq #)

Ten-day field trip during spring break emphasizing broad range of wildlife management experiences, including big game, waterfowl, and endangered species.

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 FISHERY BIOLOGY

8377. RESEARCH IN WILDLIFE BIOLOGY

8448. FISHERY SCIENCE

8451. PRODUCTION BIOLOGY OF FISHERY ENVIRONMENTS

8452. GENETICS IN AQUACULTURE AND FISHERIES MANAGEMENT

8459. STREAM AND RIVER ECOLOGY

8574. WILDLIFE MANAGEMENT: UPLAND GAME

8575. WILDLIFE MANAGEMENT: WATER-FOWL

8576. WILDLIFE MANAGEMENT: LARGE MAMMALS

8577. PERSPECTIVES IN WILDLIFE ECOLOGY

8578. WILDLIFE RESOURCE PLANNING AND DECISION MAKING

8579. ECOSYSTEM ANALYSIS AND SIMULATION: A NUMERICAL APPROACH

Forest Products (ForP)

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 use of wood products.

Course Descriptions

1102. LEADERSHIP AND MANAGEMENT SKILLS FOR COLLEGE OF FORESTRY STUDENTS. (2 cr; S-N only)

Discussions, guest talks, audiovisual programs, and in-class exercises on people management, planning and organization, meetings and group problem solving, technology transfer and introduction of change into organizations, mass media and publicity campaigns, time management, and career planning and development. Written project for an additional credit optional.

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

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

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

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

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

Visits to a number of firms involved with various facets of the forest products industry.

3301. INDUSTRIAL ASSIGNMENT. (1 cr; S/N; prereq FP cooperative education student)

Evaluation based on formal report written by student at end of each quarter or work assignment.

3303. FOREST PRODUCTS MARKETING. (3 cr; prereq Mktg 3000)

Historical and current considerations of forest products marketing at the manufacturing, wholesale, and retail levels. Lectures, guest speakers, and field trips.

3310. WOOD-FRAME BUILDING SYSTEMS AND MATERIALS. (4 cr; prereq AgET 1015, Phys 1001 or equiv)

Development and principles of manufactured housing systems. Wood-frame construction technology. Strength and other properties of wood and wood-based materials as related to design. Material and design optimization. Insulation materials and heat loss.

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.

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)

Chemical composition, reactions, and analyses of wood, wood components, and derivatives.

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 laboratory.

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, laboratory exercises, and plant visits.

5305. PULP AND PAPER TECHNOLOGY. (4 cr; prereq 5300, 5302 or #)

Pulping processes; fiber refining and processing; manufacture of paper; fiber and paper properties; recycling of paper; and water requirements and effluent treatment. Lecture and laboratory. Field trip optional.

5306. ANALYSIS OF PRODUCTION SYSTEMS. (3 cr; prereq 1301 or #, 3300 recommended)

Manufacture of wood-based products from a systems point of view. Input requirements, machinery selection, methods of economic comparison. Technology related to lumber manufacture.

5307. WOOD-BASE PANEL TECHNOLOGY. (4 cr; prereq 5300, 5301 or #)

Design, manufacture, properties, and applications of plywood, particleboard, fiberboard, and composite panels. Adhesives and their application in the panel industry. Lecture, laboratory, and research project.

5310. PULP AND PAPER PROCESS LABORATORY. (3 cr; prereq 5305 or 5305)

Chemical and mechanical pulping, pulp preparation, secondary fiber, de-inking, wet end additives. Laboratory problems and exercises supplemented by lectures.

5312. PULP AND PAPER PROCESS CALCULATIONS. (4 cr; prereq ME 3301 or #)

Chemical and physical process calculations; steady and unsteady state material and energy balances applied to pulping and papermaking processes.

5313. PULP AND PAPER PROCESS OPERATIONS. (5 cr; prereq CE 3400 or #)

Application of the principles of momentum, heat, and mass transfer to unit operations in the pulp and paper industry: fluid transport, filtration, sheet forming, sedimentation, heat exchange, evaporation, gas absorption and stripping, distillation, leaching, extraction, crystallization, humidification, and drying.

5315. PAPER ENGINEERING LABORATORY. (2 cr; prereq 5312 or #)

Experiments designed to illustrate and apply the principles of momentum, heat, and mass transfer using the pilot-plant paper machine and coater.

5316. COATED PRODUCT DEVELOPMENT. (2 cr; prereq 5310 or #)

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. SENIOR SEMINAR. (2 cr; prereq sr; A-N grading only)

Current developments in forest products.

5350. WOODY TISSUE MICROTÉCHNIQUE. (2 cr; offered when feasible)

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

5353. WOOD CHEMISTRY II. (2 cr; prereq 5302, Chem 3100, Chem 3101 or equiv)

Laboratory problems in the analysis of wood constituents and in the techniques of their isolation and purification.

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 laboratory.

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

Lectures and case studies on retail, wholesale, manufacturer, and market analysis research concerning the forest products business.

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

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 of these woods; relation of these properties to favored uses for the woods.

5361. ADHESION AND ADHESIVES. (3 cr; prereq 5359 or Chem 3302 or Chem 5520 or #)

Introduction to adhesion. Physico-chemical interactions at adhesive-adherend interface. Polymer adsorption. Polymer structure and adhesive utility. Wood as adherend. Adhesive-wood interface. Shelf-life of resins. Curing. Adhesive cohesion and performance. Adhesives from renewable resources.

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

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

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

8305. INFLUENCE OF CULTURAL/GENETIC PRACTICES ON THE STRUCTURE AND UTILIZATION OF WOODY FIBROUS MATERIALS

8306. SEMINAR: FOREST PRODUCTS

8307. ADVANCES AND METHODS IN FOREST PRODUCTS PATHOLOGY AND PRESERVATION

Forest Resources (FR)

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 laboratory methods of identification.

1101. INTRODUCTION TO AIR AND WATER QUALITY. (4 cr)

Air and water quality problems. Basic processes that govern the accretion, depletion, and cycles of specific types and sources of pollution. Methods of pollution abatement and influence of political, social, and economic pressures on the maintenance of a "quality environment."

1102. LEADERSHIP AND MANAGEMENT SKILLS FOR COLLEGE OF FORESTRY STUDENTS. (2 cr; S-N only)

Discussions, guest talks, audiovisual programs, and in-class exercises on people management, planning and organization, meetings and group problem solving, technology transfer and introduction of change into organizations, mass media and publicity campaigns, time management, and career planning and development. Written project for an additional credit optional.

Course Descriptions

1122. INTRODUCTORY SOIL SCIENCE. (4 cr; prereq Chem 1001 or 1004)

Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures and laboratory.

1200. INTRODUCTION TO FOREST RESOURCES. (3 cr)

Multiple forest resources and their management. History, policy, and current issues in forest resources. Lectures and laboratory (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.

3100. MINNESOTA PLANTS. (1 or 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 the ecology of regeneration.

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 utilization, various mill tours. Discussions, paper.

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

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

3104. FOREST ECOLOGY. (3 cr; prereq Itasca session)

Ecological concepts and principles as a basis for silvicultural practice. The forest as an ecosystem.

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.

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 (1 cr)

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

5100. SILVICULTURE. (3 cr; prereq Itasca session, 1100)

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.

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

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

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 regulation of growth. Plant biochemistry and photo-chemistry. Physiology related to silviculturally and ecologically significant phenomena.

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

Laboratory study of aspects of tree biology. Emphasis on design and conduct of experiments.

5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS. (2 cr; prereq 1122, 5114; Δ; given at Cloquet)

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

5140. APPLICATION OF SILVICULTURE IN NORTH AMERICAN FOREST TYPES. (3 cr; prereq FR 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.

5150. FOREST ECOLOGY SEMINAR. (3 cr; prereq sr, 3101, 5100 or #)

Survey of classical concepts and contemporary developments in ecology as related to forestry. Discussion group format.

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

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

5153. ADVANCED FOREST HYDROLOGY. (4 cr; prereq 3220, 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 laboratory.

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 3081 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 laboratory.

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 selected aspect of forest fire management.

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

Field exercises in prescribed burn planning and execution.

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

Supervised experience in suppression 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.

5226. FOREST ECONOMICS AND PLANNING. (5 cr; prereq FR 5212, AgEc 1030 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. Field work and presentation.

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

Basic concepts of political and administrative processes in development of forest 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.

Course Descriptions

5241. LEGAL AND POLITICAL PROCESSES IN FORESTRY. (3 cr; prereq FR 5240 or #)

Advanced concepts of political and administrative processes in development of forest policies and programs. Issue creation and agenda setting, incremental decision-making styles, role of analysis, major policy participants (e.g., courts, legislatures, interest groups, media), and theories.

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

An 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. (1 cr)

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

5253s. FOREST BIOMETRY. (3 cr; prereq 5212, Stat 5022 or #; offered alt even yrs)

Topics in forest measurements, sampling, inventory, and the modeling and analysis of forest growth and change.

5255s. FOREST RESOURCES SURVEY DESIGN. (3 cr; prereq 5212, Stat 5022, 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 student or #)

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

5260. ADMINISTRATIVE PROCESSES FOR NATURAL RESOURCE MANAGERS. (3 cr; prereq forestry jr, sr, or grad, or #)

Development of U.S. forestry and resource management organizations. Staffing, direction, organization, planning, budgeting, and related administrative practices.

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, multi-spectral, 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 sr in forestry or #)

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

5406. FORESTRY WORKSHOP FOR TEACHERS. (5 cr)

Forest ecosystems and forest management studied in lecture and laboratory 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 utilization 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 laboratory 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 5220, natural resources sr)

Working knowledge of quantitative remote sensing. Both theoretical basis and practical aspects, including energy-matter interactions, radiation measurements and sensors, and digital image analysis

5457. WATER QUALITY MANAGEMENT: FISHERIES. (2 cr; prereq Chem 1005 or equiv, 5457-8†)

Determination of suitable water quality for fish including methodology, data analysis, and general responses to natural stresses and pollutants.

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. Fishery impacts designed to supplement those discussed in FR/FW 5457.

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.

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

8108. FOUNDATIONS OF RENEWABLE RESOURCES RESEARCH

8109. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS

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

8206. ADVANCED MANAGEMENT OF RECREATIONAL LANDS

8207. ECONOMIC ANALYSIS OF FORESTRY PROJECTS

8209. SEMINAR: FORESTRY AND ECONOMIC DEVELOPMENT

8210. RESEARCH METHODS IN FORESTRY

8211. SEMINAR: FOREST POLICY ISSUES

8212. ADVANCED REMOTE SENSING

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, 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.

1142. SHORT CALCULUS. (5 cr; for students requiring minimal amount of calculus; prereq 3¹/₂ 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 who need 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.

1211-1221-1231. CALCULUS I-II-III. (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, infinite series and sequences.

3211. MULTIVARIABLE CALCULUS. (5 cr; prereq grade of C or better in 1231 or equiv)

Partial differentiation, chain rule, implicit functions, applications. Multiple integrals in two and three dimensions.

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.

Course Descriptions

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 the thesis sentence, evidence, coherence, clarity, and correctness. Relatively short (500-750 words) assignments designed to complement instruction in the Library Laboratory.

1104. LIBRARY LABORATORY. (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.

1151. WRITING IN YOUR MAJOR. (4 cr; prereq 1101, 1104, and 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 and 1104)

Practical course in 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.

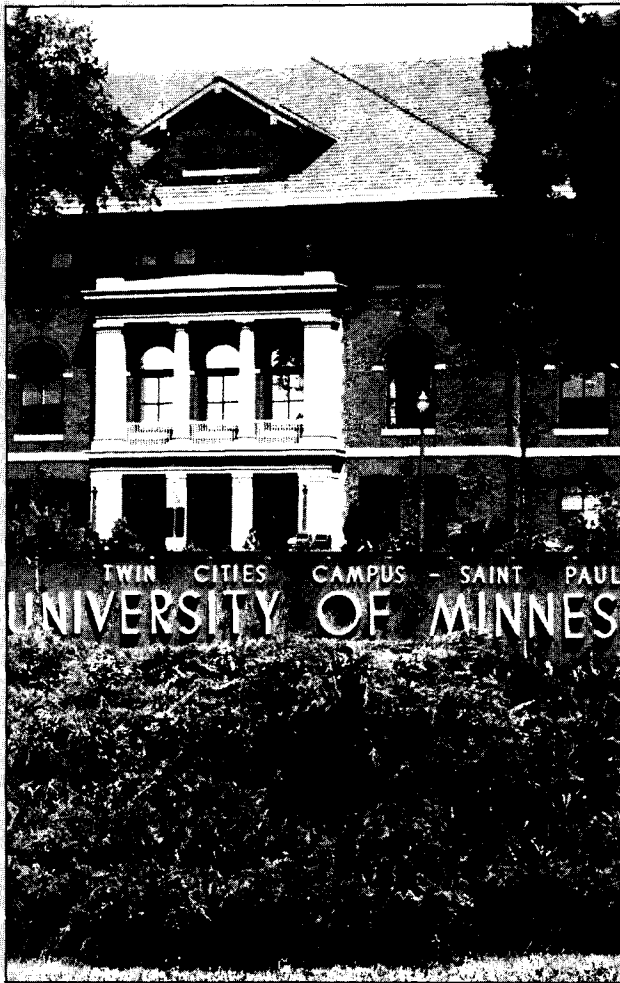
3266. COMMUNICATION, DISCUSSION IN SMALL GROUP DECISION MAKING. (4 cr; prereq 1101)

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, and jr status)

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

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²Associate member from Department of Soil Science

³Associate member from Department of Entomology, Fisheries and Wildlife

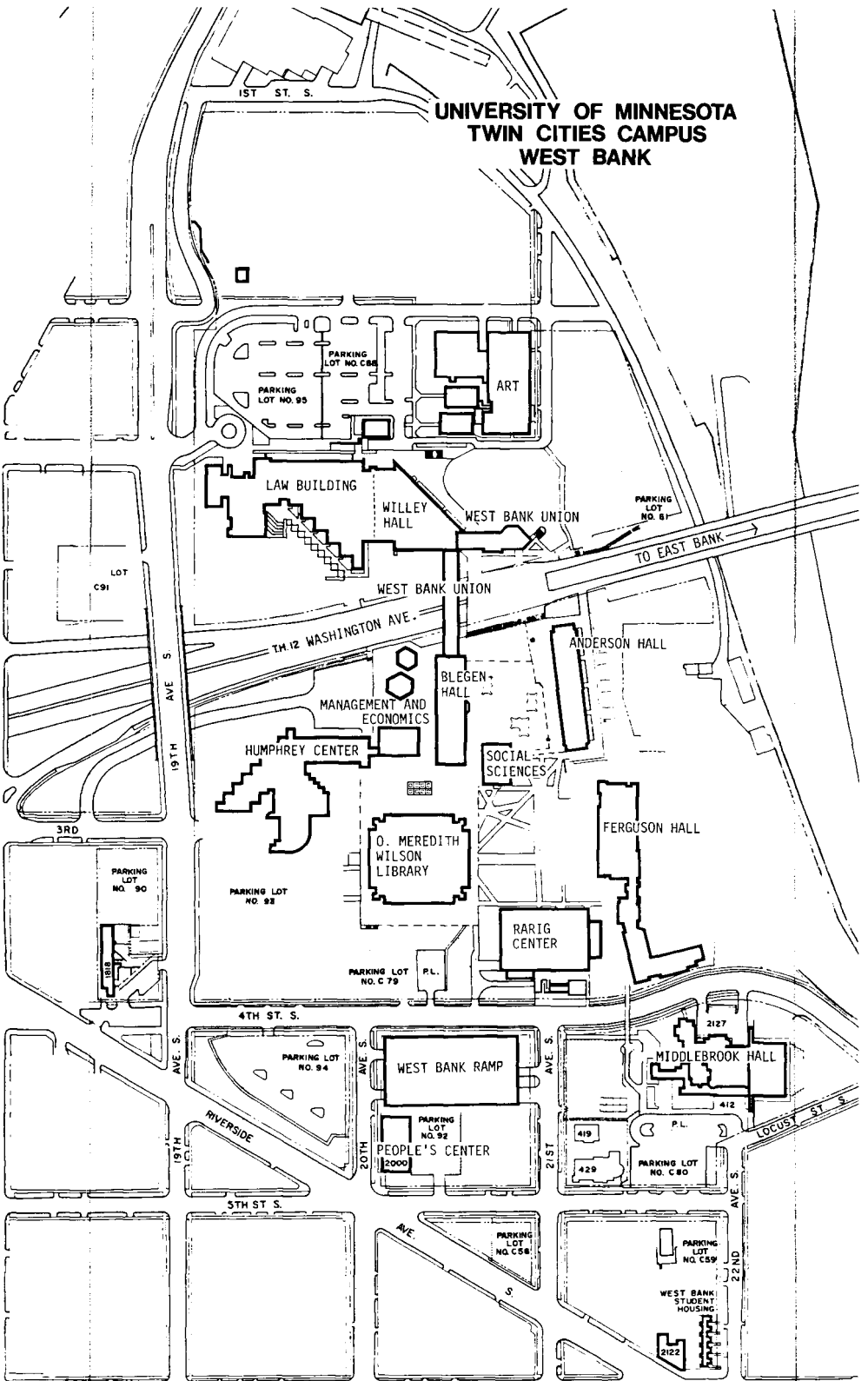
⁴Associate member from North Central Forest Experiment Station, U.S. Forest Service

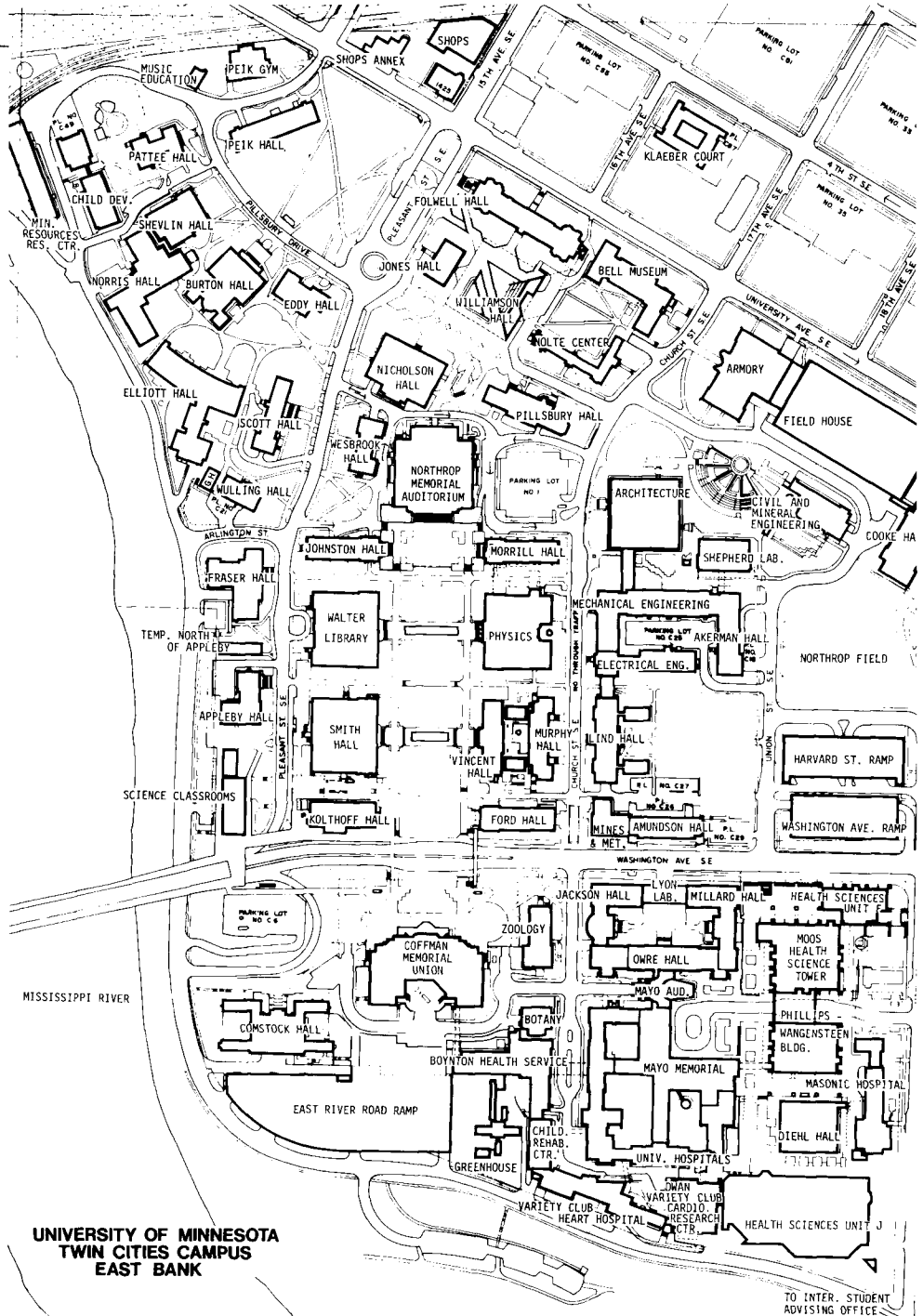
⁵Associate member from North Central Agricultural Experiment Station

⁶Associate member from Minnesota Department of Natural Resources

⁷Associate member from University of Minnesota Technical College at Waseca

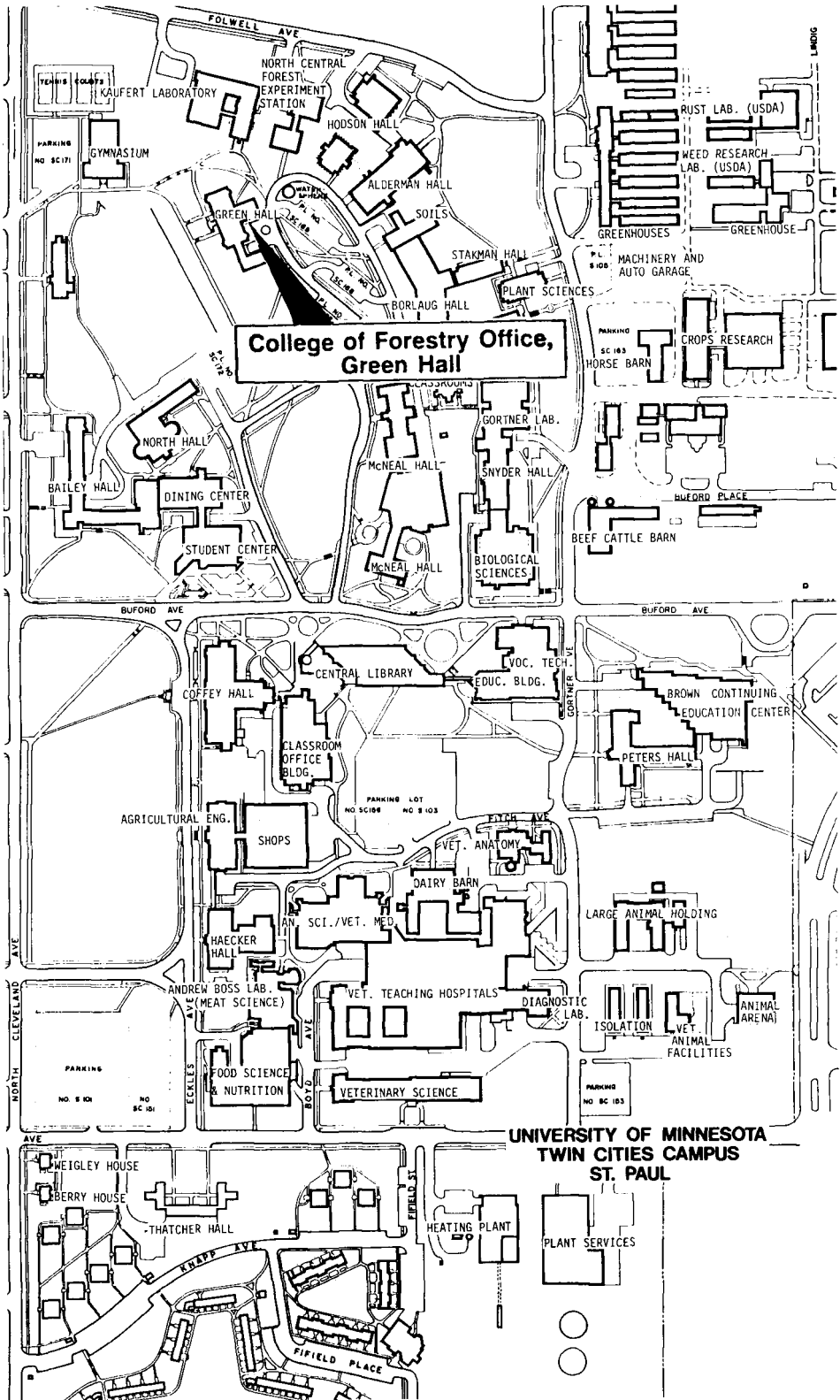
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TO INTER. STUDENT
ADVISING OFFICE



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