

This is the Introduction and General Information sections of the
1996-1999 University of Minnesota College of Natural Resources Bulletin.

College of Natural Resources

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University of Minnesota Mission Statement

The University of Minnesota, founded in the belief that all people are enriched by understanding, is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse community; and to the application of this knowledge to benefit the people of the state, the nation, and the world.

The University's mission, carried out on multiple campuses and throughout the state, is threefold:

Research and Discovery

Generate and preserve knowledge, understanding, and creativity by conducting high-quality research, scholarship, and artistic activity that benefit students, scholars, and communities across the state, the nation, and the world.

Teaching and Learning

Share that knowledge, understanding, and creativity by providing a broad range of educational programs in a strong and diverse community of learners and teachers, and prepare graduate, professional, and undergraduate students, as well as non-degree-seeking students interested in continuing education and lifelong learning, for active roles in a multiracial and multicultural world.

Outreach and Public Service

Extend, apply, and exchange knowledge between the University and society by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world.

In all of its activities, the University strives to sustain an open exchange of ideas in an environment that embodies the values of academic freedom, responsibility, integrity, and cooperation; that provides an atmosphere of mutual respect, free from racism, sexism, and other forms of prejudice and intolerance; that assists individuals, institutions, and

communities in responding to a continuously changing world; that is conscious of and responsive to the needs of the many communities it is committed to serving; that creates and supports partnerships within the University, with other educational systems and institutions, and with communities to achieve common goals; and that inspires, sets high expectations for, and empowers the individuals within its community.

Policies

Bulletin Use—The University of Minnesota will change to a semester-based academic calendar beginning academic year 1999-2000. This bulletin is the last quarter-based bulletin that will be produced for the College of Natural Resources. It covers academic years 1996-97, 1997-98, and 1998-99. Information about semester-based academic programs will be provided in the fall of 1998 in semester-transition publications.

The information in this bulletin and other University bulletins, publications, or announcements is subject to change without notice. University offices can provide current information about possible changes.

This publication is available in alternative formats upon request. Please contact the Office of Admissions, University of Minnesota, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008; e-mail admissions@tc.umn.edu).

This bulletin also is available in electronic format on Internet and may be accessed via the World Wide Web.

Course Guide—The *Course Guide*, a quarterly publication distributed at the University Bookstores, provides course information in addition to college bulletins and the *Class Schedule*.

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, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota

Statute Ch. 363; by the Federal Civil Rights Act, 42 U.S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by the Americans With Disabilities Act of 1990; by Executive Order 11246, as amended; by 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be directed to Stephanie Lieberman, Director, Office of Equal Opportunity and Affirmative Action, University of Minnesota, 419 Morrill Hall, 100 Church Street S.E., Minneapolis, MN 55455 (612/624-9547).

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. (Exceptions under the law include state and federal educational and financial aid institutions.) The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, electronic (e-mail) address, telephone number, dates of enrollment and enrollment status (full time, part time, not enrolled, withdrawn and date of withdrawal), college and class, major, adviser, academic awards and honors received, and degrees earned—is considered public or directory information. Students may prevent the release of public information only during their terms of enrollment. To do so, they must notify the records office on their campus.

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

Immunization—Students born after 1956 who take more than one University class are required under Minnesota law to submit an Immunization Record form.

The form, which is sent along with the official University admission letter, must be

filled out and returned to Boynton Health Service within 45 days of the first term of enrollment in order for students to continue registering for classes at the University. Complete instructions accompany the form.

Extracurricular Events—No extracurricular events requiring student participation may be scheduled from the beginning of study day to the end of finals week. Exceptions to this policy may be granted by the Senate Committee on Educational Policy. The Senate advises all faculty that any exemption granted pursuant to this policy shall be honored and that students who are unable to complete course requirements during finals week shall be provided an alternative and timely opportunity to do so.

Smoke-Free Campus Policy—Smoking is prohibited in all facilities of the University of Minnesota, Twin Cities campus except for designated private residence hall rooms.

Career Opportunities

Some College of Natural Resources (CNR) programs offer excellent employment opportunities. Forest products majors, particularly those pursuing a specialization in paper science and engineering, find the job market very strong. Starting salaries for these graduates range from \$38,000 to \$43,000 per year. Other forest products specializations such as production management also offer excellent job opportunities.

Forest resources graduates generally find an improved job market, partially due to fewer graduates nationwide. Recent budget cutbacks have limited opportunities to some degree with government agencies such as the U.S. Forest Service. The forest industry, Minnesota Department of Natural Resources, and county forestry programs are typical employers. Starting salaries for forestry graduates typically range from \$19,000 to \$28,000 per year. Urban forestry and recreation resource management graduates with flexibility in location enjoy a strong employment outlook.

Natural resources and environmental studies graduates have experienced relatively good job opportunities. Environmental consulting firms, soil and water conservation districts, Minnesota DNR, Minnesota Pollution Control Agency, and waste

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management firms and recycling centers are just some of the recent employers. Other employers include environmental learning and nature centers; federal agencies such as the U.S. Forest Service, Natural Resources Conservation Service, and Bureau of Land Management; and nonprofit organizations such as the Nature Conservancy.

Fisheries and wildlife graduates have also experienced relatively good job opportunities. However, these graduates should be flexible in choosing where to work, maintain above average academic records, and gain related work experience before graduation. A master's degree is advantageous. Starting salaries for fisheries and wildlife graduates typically range from \$19,000 to \$28,000 per year.

CNR offers assistance and advice to students seeking summer jobs and internships in fisheries

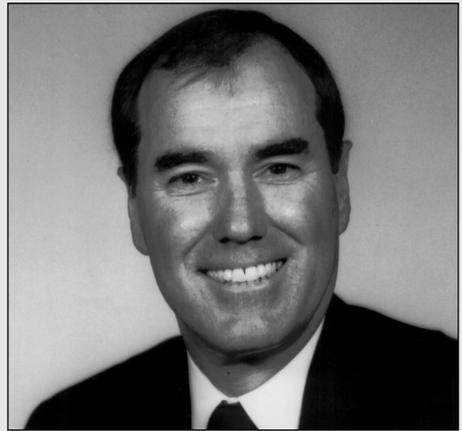
and wildlife, forestry, forest products industries, outdoor recreation, and the environment, as well as permanent employment after graduation. Job search assistance for all students, except forest products majors, is provided by the career opportunities coordinator in 135 Natural Resources Administration Building. Many faculty also advise and assist students with job searches especially in highly specialized areas such as paper science and engineering. A series of special employment seminars are provided by the Career Opportunities office on topics including résumé writing, interviewing, initiating internship job searches, and summer/seasonal intern hiring updates. Each department also requires an orientation class for incoming students that provides interaction with faculty and alumni in their chosen professional field.

Letter From the Dean

Never has there been a more exciting time to be involved in natural resources and environmental sciences. Today's society is becoming increasingly aware of the direct link between the proper management of our natural resources and our own environmental, economic, and social health. Here at the College of Natural Resources our mission is to foster a quality environment by contributing to the management, protection, and sustainable use of our natural resources through teaching, research, and outreach. I truly believe the educational opportunities you find described in this bulletin will encourage you to join us as we strive to accomplish this mission.

As a student in the college you will have the option to major in forest resources, forest products, recreation resource management, urban forestry, or fisheries and wildlife. Another option is our natural resources and environmental studies major that focuses on the interaction between natural resources and modern society and the social and environmental roles natural resources play nationally and internationally. Specific information on any of these majors is contained in the following pages.

Continuously accredited since 1935, the College of Natural Resources is recognized as



one of the leading colleges of its kind in the nation today. Building on our rich history and past successes, we continue to strive for excellence through the quality of the faculty and students we draw, as well as our strong alumni connections to industry, public agencies, research, and education.

Please consider becoming a member of our small and spirited community. I know you will not be disappointed.

A handwritten signature in dark ink that reads "Alfred D. Sullivan". The signature is written in a cursive, slightly slanted style.

Alfred D. Sullivan
Dean, College of Natural Resources

Facilities

CNR is based in five buildings on the St. Paul campus: the Natural Resources Administration Building, Green Hall, the Kaufert Laboratory of Forest Products and Wood Science, Hodson Hall, and the Engineering and Fisheries Laboratory.

The Dean's Office, Office for Student Affairs, Cold Weather Climate Housing Information Center, Forestry Library, and CNR computer laboratory are located in the Natural Resources Administration Building. The Department of Forest Resources, Graduate Studies Office, Remote Sensing Laboratory, and some Department of Fisheries and Wildlife faculty and graduate student offices are located in Green Hall.

The Department of Forest Products is in the Kaufert Laboratory, which has well equipped laboratories for teaching and research in wood products manufacturing, wood chemistry, mechanical testing, biodeterioration, and wood drying. The Department of Fisheries and Wildlife office, library, laboratories, and lecture and faculty facilities are in Hodson Hall and the Engineering and Fisheries Laboratory. 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.

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

The college's *Cloquet Forestry Center* includes more than 3,700 acres of virgin and second-growth timber in a major forest products manufacturing area of northeastern Minnesota. Forest Resources seniors spend their fall quarter at the center taking 17 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.

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 the industrial forest lands of the southern United States, and the Lake States' forest products mills and factories—are also available to students.

Degrees Offered

Baccalaureate Degrees—The bachelor of science (B.S.) degree is awarded to CNR students who satisfactorily complete 192 required and elective credits in one of five major programs: fisheries and wildlife, forest products, forest resources, recreation resource management, or urban forestry. The B.S. degree is awarded to CNR students who satisfactorily complete 180 required and elective credits in the natural resources and environmental studies program. Curricular requirements are fully explained in the Baccalaureate Programs section of this bulletin. The degree may be earned “with distinction” or “with high distinction.”

Graduate Degrees—The master of science (M.S.) and the doctor of philosophy (Ph.D.) in forestry, fisheries, or wildlife conservation, and the master of forestry (M.F.) degrees are offered through the Graduate School in cooperation with CNR. For detailed information, contact the appropriate director of graduate studies, 301 Green Hall (612/624-2774) for forestry, 200 Hodson Hall (612/624-3600) for fisheries and wildlife, or the *Graduate School Bulletin*. Interested students should apply for admission through the Graduate School, 306 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455 (612/625-3014).

Administration

Undergraduate curricula of CNR are organized within three departments: fisheries and wildlife (200 Hodson Hall); forest products (203 Kaufert Laboratory); and forest resources (115 Green Hall), which includes the recreation resource management and urban forestry programs. The college also offers the natural

resources and environmental studies curriculum. The chief administrator of each department is the department head.

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

CNR Office for Student Affairs, 135 Natural Resources Administration Building, provides admission, registration, advising, placement, and other assistance to all undergraduates.

Admission

Undergraduates seeking admission to CNR should apply through the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008). A \$25 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 Test (ACT) along with their high school rank percentile (HSR).

The formulas below show how to calculate the ACT or SAT “Aptitude Rating” using a student’s high school rank percentile and ACT or SAT test scores. If the Aptitude Rating falls at or above the number indicated for the college that a student plans to enter, the student will be admitted automatically, provided the student also has completed the high school preparation requirements below. If the Aptitude Rating falls below the number indicated, the application will be reviewed through the University’s individual review process.

Formula	Minimum Score
AAR	
<i>(ACT Aptitude Rating,</i>	
<i>for students who have taken the ACT)</i>	
HSR percentile + (2 x ACT composite score)	110
SAR	
<i>(SAT Aptitude Rating,</i>	
<i>for students who have taken the SAT)</i>	
HSR percentile + (SAT verbal ÷ 10 + SAT math ÷ 10)	160

Students seeking admission will be expected to have completed at least the following courses while in high school (grades 9-12):

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

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

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

Credits earned through special examination or University College/Continuing Education and Extension may transfer to CNR.

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.

Planning to Transfer?

Minnesota’s public colleges and universities are working to make transfer easier. You can help if you PLAN AHEAD, ASK QUESTIONS, and USE PATHWAYS created by transfer agreements.

Preparing for Transfer

If you are currently enrolled in a college or university:

- Discuss your plans with the campus transfer specialist in the Office for Student Affairs, 135 Natural Resources Administration Building.
- Call or visit your intended transfer college. You should obtain the following materials and information:
 - college catalog
 - transfer brochure
 - information on admissions criteria and on materials required for admission (e.g., portfolio, transcripts, test scores). Note that some majors have limited enrollments or their own special requirements such as a higher grade point average.
 - information on financial aid (how to apply and by what date)
- After you have reviewed these materials, make an appointment to talk with an adviser/counselor in the college or program you want to enter. Be sure to ask about course transfer and admission criteria.

If you are not currently enrolled in a college or university, you might begin by meeting with a transfer specialist or an admission officer at your intended transfer college to plan the steps you need to take.

Understanding How Transfer of Credit Works

- The receiving college or university decides what credits transfer and whether those credits meet its degree requirements. The accreditation of both your sending and your receiving institution can affect the transfer of the credits you earn.

- Institutions accept credits from courses and programs like those they offer. They look for similarity in course goals, content, and level. “Like” transfers to “like.”
- Not everything that transfers will help you graduate. Baccalaureate degree programs usually count credits in three categories: general education, major/minor courses and prerequisites, and electives. The key question is, “Will your credits fulfill requirements of the degree or program you choose?”
- If you change your career goal or major, you might not be able to complete all degree requirements within the usual number of graduation credits.

Applying for Transfer Admission

- Application for admission is always the first step in transferring. Fill out the application as early as you can prior to the deadline. Enclose the application fee.
- Request that official transcripts be sent from every institution you have attended. You might be required to provide a high school transcript or GED test scores as well.
- Recheck to be certain you supplied the college or university with all the necessary paperwork. Most colleges make no decisions until all required documents are in your file.
- If you have heard nothing from your intended college of transfer after one month, call to check on the status of your application.
- After the college notifies you that you have been accepted for admission, your transcripted credits will be evaluated for transfer. A written evaluation should tell you which courses transfer and which do not. How your courses specifically meet degree requirements may not be decided until you arrive for orientation or have chosen a major.
- If you have questions about your evaluation, call the Office of Admissions and ask to speak with a credit evaluator. Ask why judgments were made about specific

courses. Many concerns can be cleared up if you understand why decisions were made. If not satisfied, you can appeal. See “Your Rights as a Transfer Student” below.

Your Rights as a Transfer Student

- A clear, understandable statement of an institution’s transfer policy.
- A fair credit review and an explanation of why credits were or were not accepted.
- A copy of the formal appeals process.

Usual appeals steps are: 1) Student fills out an appeals form. Supplemental information you provide to reviewers—a syllabus, course description, or reading list—can help. 2) Department or committee will review. 3) Student receives, in writing, the outcome of the appeal. 4) Student can appeal decision to the Office for Student Affairs, 135 Natural Resources Administration Building.

- At your request, a review of your eligibility for financial aid or scholarships.

For help with your transfer questions or problems, see your campus transfer specialist.

Residence and Reciprocity

Residence—Because the University is a state institution, Minnesota residents pay lower tuition than nonresidents and, in many programs, receive priority consideration for admission. To qualify for resident status, students must reside in Minnesota for at least one calendar year before the first day of class attendance. For more information, contact the Resident Classification and Reciprocity Office, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-6330), or the residency office on your campus.

Reciprocity—The University has reciprocity agreements with North Dakota, South Dakota, Wisconsin, and Manitoba. The University also participates in a reciprocity program with Kansas, Michigan, Missouri, and Nebraska, for students in the following undergraduate colleges: Agricultural, Food, and Environmental Sciences; Architecture and Landscape Architecture; Biological Sciences; Education and Human Development; Human

Ecology; Natural Resources; Carlson School of Management; Pharmacy; Dental Hygiene; School of Nursing; and Institute of Technology. If you are a resident of any of these states or this province, you may qualify for reciprocity tuition rates, which are lower than nonresident tuition rates and, in some cases, comparable to resident rates. For more information, contact the Resident Classification and Reciprocity Office, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-6330), or the residency office on your campus.

Financial Aid

Scholarships, grants, loans, and work-study programs available University-wide to eligible students are administered through the Office of Scholarships and Financial Aid, 210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455 or 197 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-1665). Applications are available from either of these student financial aid offices and from most Minnesota high school guidance offices. Students should apply as soon 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 CNR students are listed below. These awards are administered by the college’s scholarship committees. *Awards may vary each year 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 CNR Office for Student Affairs for application information.

CNR Scholarships and Awards

Mary Dwight Akers Loan—Sponsor anonymous. Limited loans as needed and approved by the CNR scholarship chair. 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,

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Minnesota. For forest products juniors and seniors in the marketing and production management specializations on the basis of academic achievement and professional promise. One or more \$1,500 awards annually.

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

R.M. Brown Scholarship—Sponsored by donations to CNR. For a forest resources or natural resources and environmental studies senior with a special interest in mensuration or statistics. One \$500 award annually.

Carolind Scholarships—Sponsored by the late Dr. Ralph M. Lindgren. For deserving and outstanding undergraduates. Number per year varies. \$500 each.

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

Day Family Scholarship—Sponsored by Vivian and Maurice Day and their son Norman Day. Awarded to a sophomore or junior studying forest management. One \$500 award annually.

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

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

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

Forest Products Marketing Scholarships—Sponsored by the Forest Industry Fraternity of Minneapolis and St. Paul. For deserving and

promising forest products juniors or seniors in the marketing specialization. One or two \$1,000 awards annually.

Thomas W. French Memorial Scholarship—Sponsored by Dr. David and Audrey French. For juniors and seniors. Recipient must have strong interest in urban forestry and a high degree of professional promise. One or more \$1,000 awards annually.

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

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

Frank H. Kaufert Scholar—Sponsored by CNR alumni and friends. For students within three quarters of graduation on the basis of academic accomplishments, progress toward degree, and leadership and professional promise. One or more \$2,500 awards annually.

Dayton Kirkham Scholarship—Sponsored by the late Mr. Dayton Kirkham. For entering high school seniors and transfer students on the basis of outstanding academic ability and strong desire to pursue careers in natural resource management. One to two \$750 awards (\$4,500 total for four years) are available to entering first-year students and three \$1,250 awards (\$2,750 total for two years) to transfer students.

Timothy B. Knopp Memorial Scholarship—Sponsored by the Timothy Knopp family and friends for a junior or senior on the basis of demonstrated environmental awareness and interest in the ethics of conservation, and a high degree of professional promise and scholarship. One \$500 award annually.

Ludden Scholarship—Sponsored by the Ludden Trust Fund of the Institute of Agriculture, Forestry, and Home Economics. For undergraduates on the basis of professional commitment, financial need, student organization involvement, and personal attributes. One \$1,000 award annually.

Oscar L. Mather Scholarship—Sponsored by the Minnesota Federation of Women’s Clubs and Mrs. Oscar L. Mather, Madison Lakes, MN, 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 or more \$750 awards 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 or more \$500 awards 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 or production management. One or more \$2,500 awards annually.

Mutual of Omaha Marlin Perkins Scholarship—Sponsored by Mutual of Omaha. For a student with senior class standing, a desire to work in wildlife conservation, natural resources management, or environmental education. One \$1,000 award annually.

Natural Resources Alumni Society Scholarship—Sponsored by the Natural Resources Alumni Society. For juniors and seniors on the basis of student involvement in college-related activities, professional promise, leadership, personal attributes, and academic aptitude. Six \$1,000 awards 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 alternate years. (Available to qualified graduate student for interim year.)

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

Paper Chase Scholarship—Sponsored by BE&K, Inc. For a paper science and engineering student preparing to work as an engineer in the pulp, paper, and allied support industries. One or more \$500 to \$1,000 awards annually.

Paper Science and Engineering Scholarships—Sponsored by manufacturing and supply companies representing the pulp, paper, and allied support industries, and by paper science and engineering alumni. Administered by the University of Minnesota Paper Science and Engineering Council and the Department of Forest Products. For paper science and engineering students on the basis of academic performance and professional promise. \$600 for freshmen, \$1,200 for sophomores, \$1,800 for juniors, and \$2,400 for seniors—total of \$6,000. Current sponsors include Akrosil, Division of International Paper; Albany International; Appleton Papers, Inc.; BE&K, Inc.; Betz Laboratories, Inc.; Blandin Paper Company; Boise Cascade Corporation; Buckman Laboratories, Inc.; Champion International; Consolidated Papers Foundation, Inc.; Cross Pointe Paper Corp.; Diversey Wyandotte; Englehard Corporation; H.B. Fuller Company Foundation; Henkel Chemical Company; Hennepin Paper Company; Hercules, Inc.; Jefferson Smurfit; Lake States Section, Technical Association of the Pulp and Paper Industry (TAPPI); Lake Superior Paper Industries; 3M Paper Technology Center; Minnesota Forestry Association; Nalco Chemical Company; Nekoosa Packaging; North Central Division, Packaging Corporation of America; Paper Industry Management Association (PIMA); Penford Products Company; Potlatch Foundation for Higher Education; Repap Wisconsin, Inc.; Waldorf Corporation; and alumni and personal contributors.

Kimberley Ann Paulsen Scholarship—Sponsored by the Paulsen family and friends. For undergraduates in the natural resources and environmental studies curriculum on the basis of financial need, environmental awareness, leadership, and academic achievement. One \$500 award annually.

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

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

Henry Schmitz Forest Products Engineering Scholarship—Sponsored by Dr. Stanley J. and Mertie W. Buckman, Memphis, Tennessee. For a forest products junior or senior on the basis of academic achievement and professional promise. One or more \$1,000 awards 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. Two to five \$500 awards annually.

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

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

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

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

Student Activities

Governance—Students may participate in governance activities at the department, college, and campus levels. Within each department, several committees (including curriculum committees) have student representatives. Students also serve on CNR committees and on

the college's Student-Faculty Board, which advises the dean on student problems and concerns. Students also participate in the St. Paul Campus Board of Colleges, which directs student activities and acts as a liaison between the student body and administration, and on the Student Center Board of Governors, which establishes programs, operation policies, and budgets for the St. Paul Student Center.

Clubs—Student clubs in the college include the Environmental Studies Club, Forestry Club, student chapter of the Society of American Foresters, Recreation Resource Management Club, Forest Products Society—Student Chapter, Technical Association of the Pulp and Paper Industry (TAPPI), Paper Industry Management Association (PIMA), Fisheries and Wildlife Club (with an affiliated student chapter of The Wildlife Society), Minnesota Women in Natural Resources Student Organization, and Xi Sigma Pi Honor Society. Through these clubs, students hold an annual Forester's Day, support a scholarship fund by selling Christmas trees, attend events such as the Midwest Fish and Wildlife Conclave and the Midwestern Foresters Conclave, and produce and market wood identification kits. Xi Sigma Pi Honor Society holds an annual banquet and administers a student speakers bureau.

University Counseling and Consulting Services

University Counseling and Consulting Services (UCCS) offers counseling for academic, career, personal, or relationship concerns. Besides counseling, UCCS features a variety of services. The Career Resource Center and the Learning and Academic Skills Center offer workshops, courses, and materials for career development or academic skills improvement. The Organizational Development Program offers consultation, assessment, team building, conflict mediation, training, and workshops. UCCS's Measurement Services office administers tests; scores exams, surveys, and research instruments for University faculty; and operates the Minnesota Statewide Testing Program for Minnesota elementary and secondary schools. The Testing Center administers admissions, placement, and national tests.

This is the Baccalaureate Programs section of the 1996-1999 University of Minnesota College of Natural Resources Bulletin.

Six Major Curricula

CNR offers six major curricula leading to the bachelor of science (B.S.) degree: (1) fisheries and wildlife (with specializations in fisheries, wildlife, and conservation biology); (2) forest products (with specializations in marketing, production management, paper science and engineering, and wood science); (3) forest resources (with tracks in forest management and forest science); (4) natural resources and environmental studies; (5) recreation resource management; and (6) urban forestry. Because the first year of coursework is somewhat similar, students may transfer between curricula at the end of their freshman year with little or no credit loss.

Academic Policies

Adviser—Each student, with adviser assistance, is responsible for learning curricular and graduation requirements and developing a course program and timetable to meet them. Freshmen and first-year transfer students in the forest resources, fisheries and wildlife, natural resources and environmental studies, recreation resource management, and urban forestry curricula are assigned an adviser in the CNR Office for Student Affairs. Forest products students are assigned a faculty adviser within that department.

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

Repeating Courses—Students may repeat a course even if a passing grade was received. The grade received for the course the second time becomes the permanent grade. The original grade and credits are not included in the student's cumulative number of completed credits or grade point average (GPA). It is the student's responsibility to report any repeated courses to the CNR Office for Student Affairs.

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

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

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

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

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

Registration—The quarterly *Class Schedule* contains general registration and refund information.

Students who find it necessary to cancel or add courses after registering for the quarter should refer to the *Class Schedule* for instructions.

If a student withdraws from the college at any time, all classes should be officially canceled.

Cancel/add requirements

Week of class	Required to cancel	Required to add
Week 1	—	—
Week 2	—	—
Weeks 3-6	—	Instructor and college scholastic committee approval
Weeks 7-10	College scholastic committee approval	College scholastic committee approval

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

1. A maximum of 25 percent of the residence credits presented for the baccalaureate degree may be in courses in which a grade of S was received.
2. *All required courses must be taken A-F.* Prerequisites for required courses and courses in the major must also be taken A-F unless an exception is made.

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

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

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

Conditions for probation and suspension

Student status	Probation	Suspension
	Cumulative GPA after first two quarters in college is below	Cumulative GPA after first two quarters in college is below
Freshman	1.90	1.60
Sophomore	2.00	1.90
Upper Division	2.00	1.90
	or any combination of three D and N or F grades in any one quarter	or any combination of three D and N or F grades in three consecutive quarters or two consecutive quarters of probation

The Student Scholastic Standing Committee places a student on probation and informs him or her that repeated low academic performance will lead to a suspension. A suspension 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 is not considered as a separate quarter. Itasca grades are included with fall quarter grades.

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

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

Policy Waivers—Occasionally it may be to the educational advantage of both the student and the department to waive an academic policy or

curricular requirement, provided the basic spirit of the regulation is maintained. A student may petition for a departure from normal procedure. If approved by the adviser, the petition is routed to the department Student Scholastic Standing Committee for a final decision. Contact the CNR Office for Student Affairs for more information.

Graduation Requirements

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

1. Complete a minimum of 192 credits (180 for natural resources and environmental studies), including required and elective courses in the chosen curriculum. No more than 9 credits in physical education may be applied toward the degree. No more than 9 credits in music may be applied as elective credits toward the degree.
2. Achieve a GPA of 2.00 or higher with no more than 5 credits of D in required forest resources, forest products, natural resources and environmental studies or fisheries and wildlife designator courses and 5 credits of D in other required courses.
3. Satisfy liberal education requirements (see below).
4. Satisfy residence and other general University requirements for graduation.

Note: Transfer students must complete a minimum of 45 credits, 30 during the senior year, while attending CNR.

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

Fisheries and wildlife majors who qualify may enroll in an honors program in which the B.S. degree may be earned *cum laude*, *magna cum laude*, and *summa cum laude*. (See Honors Program, page 23.)

Transfer students who have completed less than half the credits required for graduation while attending CNR are not eligible to graduate with honors.

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

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

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

CNR accepts CLEP scores at the 75th percentile or higher for exemption from up to 8 credits in a selected number of courses.

Computer Competency—Computer skills are necessary for today’s student. As a student in CNR, you will use computer applications in your coursework regardless of the major you choose. You will be expected to have basic computer competency in word processing, spreadsheets, database management, and telecommunications. Your level of computer competency will be assessed in the advising process. If you lack needed skills, you will be given advice on which courses you will be required to take in order to learn those skills.

Liberal Education Requirements

Effective for all freshmen with fewer than 39 credits enrolling from fall 1994 to summer session II 1996. Beginning fall 1996, the liberal education requirements apply to all students entering a baccalaureate degree program, regardless of prior credits.

A liberal education introduces you to the modes of inquiry and subject matter of the major branches of knowledge, including the factual information and theoretical or artistic constructs that form their foundations; the “ways of knowing”—the kinds of questions asked and how insight, knowledge, and data are acquired and used; the changes over time of their central ideas or expressive forms; and the interrelationships among them and with human society in general. To these ends, study by all undergraduate students on the Twin Cities campus is guided by a common framework.

The Diversified Core Curriculum

Physical and Biological Sciences. Comprehension of physical and biological principles; understanding of and ability to use the methods of scientific inquiry—the ways in which scientists investigate physical and biological phenomena; and appreciation of the importance of science and the value of a scientific perspective.

Requirement: A minimum of three courses totaling at least 12 credits, including one course with a laboratory or field experience in the physical sciences and one course with a laboratory or field experience in the biological sciences.

History and Social Sciences. Knowledge of how historians and social scientists describe and analyze human experiences and behavior; study of the interrelationships among individuals, institutions, structures, events, and ideas; understanding of the roles individuals play in their historical, cultural, social, economic, and political worlds.

Requirement: A minimum of three courses totaling at least 12 credits, including one course with historical perspective.

Arts and Humanities. Understanding of approaches to the human condition through works of art, literature, and philosophy; knowledge of how artists create and humanistic scholars think; ability to make aesthetic judgments.

Requirement: A minimum of three courses totaling at least 12 credits including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Mathematical Thinking. Acquisition of mathematical modes of thinking; ability to evaluate arguments, detect fallacious reasoning, and evaluate complex reasoning chains; appreciation of the breadth of applications of mathematics and its foundations.

Requirement: A minimum of one course totaling at least four credits.

The Designated Themes of Liberal Education

The designated themes of liberal education offer a dimension to liberal learning that complements the diversified core curriculum. Each of the themes focuses on an issue of compelling importance to the nation and the world, the understanding of which is informed by many disciplines and interdisciplinary fields of knowledge.

Requirement: A minimum of six courses (or five courses if one includes an approved practicum), including one course in each of the following:

Cultural Diversity. Understanding of the roles gender, ethnicity, and race play in structuring the human experience in and developing the social and cultural fabric of the United States.

International Perspectives. Comprehension of the ways in which you are part of a rapidly changing global environment dominated by the internationalization of most human endeavors.

Environment. Knowledge of the interaction and interdependence of the biophysical systems of the natural environment and human social and cultural systems.

Citizenship and Public Ethics. Reflection on and determination of a clearer sense of your present and future civic relationships and your obligations to the community.

Writing Skills

The ability to communicate effectively is a hallmark of a liberally educated individual and a key to a successful and satisfying life. To encourage refining of writing skills, the liberal education curriculum includes both writing courses and writing across the curriculum.

Requirement: Writing skills requirements are being revised. Until the new requirements are in effect, all students will complete the writing requirement specified by the college awarding their baccalaureate degree.

You may satisfy the liberal education requirements with a number of courses and credits different from those of other students because some courses serve multiple goals in the curriculum; e.g., some courses will satisfy a diversified core requirement and a designated theme requirement, and other courses will satisfy the requirements for each of two themes. Thus, you may satisfy the designated theme requirements with a smaller number of courses than is stated in the requirement. Each quarter, the *Class Schedule* will publish the requirements and list all courses that satisfy them. In addition, the *Class Schedule* will list which of these courses are offered that quarter and which are tentatively scheduled for the subsequent quarters during the academic year.

Minnesota Transfer Curriculum

If you complete the Minnesota Transfer Curriculum at any participating Minnesota college or university, you fulfill the University’s Twin Cities campus liberal education requirements. However, you will still need to complete a portion of the writing skills requirements. Contact your college advising office concerning these requirements. For more information on using transfer credits for the liberal education requirements, contact the Office of Admissions (612/625-2008).

Itasca Session—Forest resources, urban forestry, and fisheries and wildlife majors are required to complete a 3½-week Lake Itasca Forestry and Biological Station summer term. To attend, students must have completed 40 credits and attained a minimum cumulative GPA of 2.00. Forest resources and urban forestry students must also have completed the following courses with a grade of C or better: Biol 1103, Chem 1001 or 1051, and Math 1008 (students with a C or better in high school trigonometry are exempt from Math 1008). Fisheries and wildlife students must have completed the following courses with a grade of C or better: Biol 1009, 1103, 1106, and 5041 or 3008. The session is also open to students not enrolled in CNR.

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

Cloquet Session—Students in forest resources are required to complete the Cloquet Forestry Session in the fall of their senior year. To attend, students must have attained a minimum cumulative GPA of 2.00 at the end of the preceding quarter and completed the Itasca Session and FR 1100, 3103, 3300, 5100, 5114, 5200, 5212, 5215, 5218, 5232, Soils 1020, and FW 3054.

Special Learning Opportunities

Minnesota-Idaho Student Exchange—Forest resources students at the University of Minnesota may study timber harvesting in Idaho during their senior year under an exchange agreement with the University of Idaho. Minnesota students return from this study in Idaho to be awarded their baccalaureate degree from the Department of Forest Resources. In turn, Idaho students take coursework in paper science and engineering at the University of Minnesota.

Forest Products Cooperative Education Program—Students in this program alternate periods of employment in their career fields with periods of academic study. The program leads to a B.S. in forest products, with a specialization in paper science and engineering,

production management, marketing, or wood science. Full-time students who have declared a major in forest products and who have a 2.70 GPA may apply.

Students must complete at least two quarters of academic study before their first quarter of work. At the end of each work quarter, students must submit a written report on their work assignments and learning experiences to a faculty member. Successful reports are graded S (satisfactory) and one credit is awarded for completing a work quarter. Continuation of the program is based on indication of normal progress toward the degree, a 2.50 cumulative GPA, and satisfactory work progress. For more information, contact Dr. Joseph Massey, Department of Forest Products head, 209 Kaufert Laboratory (612/624-7459).

Fisheries and Wildlife Field Trip—Fisheries and wildlife majors are eligible to participate in a field trip during spring break of their senior year. Selection for participation is competitive, based on previous academic performance. Students travel with a faculty member or graduate student(s) to the western United States to observe and discuss ongoing fisheries and wildlife management activities. Local agency personnel provide on-site information. Selected students register for one credit of FW 5565—Fisheries and Wildlife Ecology and Management: Field Trip either during winter or spring quarters.

Study Abroad—CNR students have many opportunities to study abroad. Study in English is possible at a number of sites. If a University of Minnesota program does not meet a student's needs, many other options are available.

Identifying Study Abroad Opportunities—The *Study Abroad Catalog* describes the broad range of opportunities for University of Minnesota students to study in another country as part of their degree program. Students can learn more about these options through an advising appointment at the International Study and Travel Center (ISTC), 102 Nicholson Hall ((612) 626-9000). After identifying one or more options of interest, students should see a Global Campus adviser in 106 Nicholson Hall ((612) 625-3379) for detailed program information and credit and financial aid planning.

Study Abroad Opportunities in Natural Resources—Two types of study abroad that can especially enhance degree work in CNR are field study and integrated classroom study. Minnesota Studies in International Development (MSID) is a field study program offering two-quarter winter/spring grassroots internships in Ecuador, India, Jamaica, Kenya, Morocco, or Senegal, preceded by on-campus preparatory courses in the fall. The Student Project for Amity among Nations (SPAN) consists of summer overseas research on a topic of the student's choosing, preceded by a year's on-campus preparation and followed by project write-up in the fall; the four destinations change from year to year. The University also cosponsors two specialized options for CNR students: a tropical biology/conservation program in Costa Rica and a marine biology program in Denmark.

Integrated classroom study programs permit students to take regular university courses alongside host-country nationals. The University's student exchanges and consortium memberships provide access to universities in many countries. Conservation and resource management curricula taught in English are available in Australia, Canada, Fiji, Finland, the Netherlands, the Philippines, and the United Kingdom. Students with sufficient language fluency may instead choose to study in Dutch (the Netherlands), Finnish (Finland), French (France), German (Germany), Italian (Italy), Korean (South Korea), Portuguese (Brazil), Spanish (Argentina, Colombia, Spain, Uruguay), Swedish (Finland, Sweden), or Thai (Thailand).

Other Study Abroad Opportunities—CNR students need not necessarily seek credit in their major. Study abroad is encouraged for language acquisition or cultural learning. The resulting credits can often be used as electives. The University and other institutions sponsor a broad range of intensive language and area studies programs. Contact ISTC for more information.

Credit and Financial Aid—Advance planning and CNR endorsement are essential to assure that credit from study abroad fits smoothly into the student's degree program. Students who enroll in a University of Minnesota program will receive procedural information from the sponsoring office on

campus. Those who select any other option should make an appointment with a Global Campus adviser, 106 Nicholson Hall (612/625-3379), as early as possible to discuss credit procedures and obtain a Foreign Study Checklist. Through the checklist, the CNR Office for Student Affairs, 135 Natural Resources Administration Building, will record agreements concerning credit. The checklist also helps maintain the student's enrollment status and financial aid eligibility while abroad.

For nearly all study abroad programs, students can arrange to retain their University financial aid eligibility and/or defer past loans. Additional financial aid is available for some programs. Contact ISTC for more information.

Fisheries and Wildlife

The fisheries and wildlife curriculum provides students with a broad science background emphasizing biological and environmental sciences and other coursework needed for careers in fisheries, wildlife, conservation biology, and other natural resource and environmental fields. Graduates are prepared to research, plan, and implement the management, protection, and enhancement of fisheries and aquatic resources, wildlife resources, and biological diversity. Graduates find employment as fisheries and wildlife scientists and managers, naturalists, zoo biologists, environmental biologists, environmental educators, and other natural resource professionals.

The program also provides students with the fundamental science background needed to enter a wide variety of graduate programs in biological and natural resource sciences as well as professional programs in veterinary medicine (see page 22), environmental law, and environmental education. Undergraduate-level study satisfies only minimum requirements for professional employment, whereas graduate-level study enhances career opportunities. The master's degree is required for many management, administrative, and research positions in biological and natural resource professions. The doctorate may be required for some research positions and college teaching.

Areas of Specialization

After completing a core curriculum of 115 to 130 credits that includes liberal education, basic science, mathematics, and an introduction to fisheries and wildlife, students select an area of specialization, usually by the end of the sophomore year. The three areas of specialization are fisheries, wildlife, and conservation biology. At the undergraduate level, these specializations allow students to focus on particular areas of personal interest but are not so specialized as to exclude employment across a broad range of natural resource careers.

Fisheries—This specialization is for students who wish to pursue careers in fisheries and aquatic resources science, management, and administration; fish hatchery management; and aquaculture, aquatic education, and aquatic environmental assessment. The curriculum meets the education criteria for the Certified Fisheries Scientist designation established by the American Fisheries Society, the major professional organization for fisheries scientists and managers in North America.

Wildlife—This specialization is for students who wish to pursue careers in wildlife science, management, and administration; zoo biology; and terrestrial ecology, environmental assessment, and education. With proper selection of electives, students can meet the education criteria for the Certified Wildlife Biologist designation established by The Wildlife Society, the major professional organization for wildlife scientists and managers in North America.

Conservation Biology—This specialization is for students interested in careers dealing with a broad range of conservation issues in both aquatic and terrestrial habitats. Positions typically focus on protection of endangered species and management for biodiversity. Careers as environmental educators or naturalists are also options. Course options allow students to meet their individual needs and interests.

Each specialization requires that students take a number of courses fundamental to the specialty area and select from a wide variety of courses in supporting areas. Students must also satisfy University-wide liberal education requirements in the diversified core curriculum, the designated themes of liberal education, and writing skills. To a large extent, these requirements are built into the

curriculum or can be met by careful selection of electives. Although no computer course is required, students are expected to be computer literate and competent using word processing, spreadsheet, and e-mail software. NRES 1020—Information Technology in Natural Resources (2 credits) is recommended for students without computer skills.

Although the three specializations qualify students for admission to most graduate programs in the biological sciences, an honors program (see page 23) is available and specifically designed for highly qualified students who know at an early stage that they intend to pursue graduate education.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated theme requirements. Refer to the fisheries and wildlife curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Communication Skills

- Rhet 1101—Writing to Inform and Persuade (4)
or Comp 1011—Writing Practice (5)
- Rhet 3562—Writing in Your Profession (4)
or Comp 3015—Writing About Science (4)
- Rhet 1222—Public Speaking (4)
or Spch 1101—Fundamentals of Speech Communication (4)

Mathematical Thinking

- Math 1251, 1252—One-Variable Differential and Integral Calculus I-II (4,4)
- Math 1261—Calculus III (4)
or Math 1131—Finite Mathematics (5)
- Stat 3011, 3012—Statistical Analysis (4,4)

Physical and Biological Sciences

- Biol 1106—General Zoology (5)
- Chem 1051, 1052—Chemical Principles I-II (4,4)
- BioC 1401—Elementary Biochemistry (4)
- GCB 3022—Genetics (4)

Select one of the following groups:

- Biol 1009—General Biology (5)
and Biol 1103—General Botany (5)
- or Biol 1201—Evolutionary and Ecological Perspectives (5)
and Biol 1202—Molecular and Cellular Perspectives (5)
and Biol 1203—Organismal Adaptation and Diversity (5)

Select one of the following groups:

- Phys 1041, 1042—Introduction to Physics (5,5)
and Geo 1001—The Dynamic Earth: Introduction to Geology (5)
or Geo 1019—Our Changing Planet (4)
or Geo 1601—Oceanography (4)
or Ast 1021H—Introduction to Astronomy (4)
or Geog 1425—Introduction to Meteorology (4)
- or Phys 1104, 1105, 1106—General Physics (5,5,5)
and Phys 1107, 1108, 1109—General Physics Laboratory (1,1,1)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

One economics course (4)
One history course (4)
One social sciences course (4)

Arts and Humanities—Minimum of three totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Additional Fisheries, Wildlife, and Conservation Biology Core Courses

Biol 3008—Ecology and Evolution (4)
FW 1001—Orientation in Fisheries and Wildlife (1)
FW 3052—Introduction to Fisheries and Wildlife Conservation (3)
FW 5701, 5702—Senior Project (1,2)
or FW 5801H, 5201H—Honors Research (3,3)
and FW 5200H—Honors Seminar (1)
NRES 3010—Ethics and Values in Resource Management (3)

Areas of specialization

Fisheries

Group 1—Communications, Leadership, Policy
NRES 3002—Leadership and Management Skills Development (3)
or NRES 5240—Natural Resources Policy and Administration (3)

Group 2—Animals and Plants

EEB 5136 Ichthyology (4)

Select two of the following:

PBiol 5231—Introduction to the Algae (5)
PBiol 1009—Minnesota Plant Life (4)
PBiol—Introductory Plant Systematics (4)
Ent 5360—Aquatic Entomology (3)
Ent 1005—Economic Entomology (4)
or Ent 5020—Insect Taxonomy (4)

Group 3—Community and Ecosystem Ecology

Select one of the following:

EEB 5052—Theoretical Population Ecology (4)
EEB 5607—Ecology of Animal Plankton (5)
EEB 5608—Ecosystem Form and Function (4)
EEB 5652—Community and Ecosystem Processes (5)

Group 4—Fisheries, Wildlife, and Conservation Biology

FW 3106—Important Plants in Fisheries and Wildlife Habitats (Itasca) (2)
FW 5600—Fisheries and Wildlife Field Techniques (Itasca) (4)
FW 5601—Fisheries Population Analysis (4)
FW 5604—Fisheries Ecology and Management (3)

Group 5—Miscellaneous Required Courses

EEB 5601—Limnology (4)
FW 5459—Fish Physiology (4)
or Biol 3111—Animal Biology (4)
or AnSci 3301—Systemic Physiology (6)
or EEB 5156—Comparative Animal Physiology (3)

Select one of the following:

Chem 3100—Quantitative Analysis Lecture (3)
and Chem 3101—Quantitative Analysis Lab (2)
or Chem 3301—Organic Chemistry I (4)
and Chem 3305—Organic Chemistry Lab I (2)

Electives—Select any course from the list below, from any of the three areas of specialization, or as approved by your adviser to total 192 credits for graduation with the B.S. degree.

AgEt 5410—Hydrology and Water Quality (5)
or FR 5114—Forest Hydrology and Watershed Management (4)
EEB 5621—Limnology Laboratory (2)
FW 5455—Aquaculture (3)
FW 5461—The Behavior of Fishes (3)
NRES 3001—Colloquium in NRES: Exotic Animals and Plants (2)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
NRES 3800—Natural Resources Interpretation and Communication (3)
NRES 5001—Colloquium in NRES: Aquatic Restoration (1)
NRES 5242—Management of Natural Resources Conflict (3)
Wildlife
Group 1—Communication, Leadership, Policy
NRES 3202—Leadership and Management Skills Development (3)
or NRES 5240—Natural Resources Policy and Administration (3)

Group 2—Animals and Plants

FW 5129—Mammalogy (5)
EEB 5134—Introduction to Ornithology (5)

Group 3—Community and Ecosystem Ecology

Select one of the following:

EEB 5052—Theoretical Population Ecology (4)
EEB 5601—Limnology (4)
EEB 5608—Ecosystem Form and Function (4)
EEB 5652—Community and Ecosystem Processes (5)
FR 5142—Tropical Forest Ecology (4)

Group 4—Fisheries, Wildlife, and Conservation Biology

EEB 5051—Analysis of Populations (4)
FW 3106—Important Plants in Fisheries and Wildlife Habitats (Itasca) (2)
FW 5600—Fisheries and Wildlife Field Techniques (Itasca) (4)
FW 5603—Wildlife Habitats and Management (3)

Group 5—Miscellaneous Required Courses

Select one of the following:

Biol 3111—Animal Biology (4)
AnSci 3301—Systemic Physiology (6)
EEB 5156—Comparative Animal Physiology (3)

Select one of the following:

LA 5202—Landscape Ecology (3)
EEB 5014—Ecology of Vegetation (5)
EEB 5016—Ecological Plant Geography (5)
EEB 5122—Plant/Animal Interactions (4)

Select two of the following:

FW 5570—Avian Conservation (4)
FW 5620—Geographic Information Systems for Fisheries, Wildlife, and Biological Conservation (4)
or FR 5130—Geographic Information in Natural Resources Analysis (3)
FR 5100—Silviculture (4)
or NRES 3020/5020—Plant Resource Management and the Environment (4)
FR 5114—Forest Hydrology and Watershed Management (4)
FR 5231—Range Management (3)
FR 5232—Management of Recreational Lands (4)
FR 5262—Remote Sensing of Natural Resources (4)
NRES 3575/5575—Wetlands Conservation (3)
EEB 3111—Introduction to Animal Behavior (4)
EEB 5044—Evolution (4)
EEB 5034—Population and Quantitative Genetics (4)

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Ent 1005—Economic Entomology (4)
Ent 5040—Insect Ecology (4)
Hort 5015—Restoration and Reclamation Ecology (4)
Stat 5301—Designing Experiments (5)

Electives—Select any course from the list below, from any of the three areas of specialization, or as approved by your adviser to total 192 credits for graduation with the B.S. degree.

NRES 3001—Colloquium in NRES: Exotic Animals and Plants (2)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)
NRES 5218—Assessment and Modeling of Forests (3)
NRES 5242—Management of Natural Resources Conflict (3)

Conservation Biology

Group 1—Communications, Leadership, Policy

NRES 3202—Leadership and Management Skills Development (3)
NRES 5240—Natural Resources Policy and Administration (3)
NRES 5242—Management of Natural Resources Conflict (3)

Group 2—Animals and Plants

Select three of the following, including one plant and one animal course:

FW 5129—Mammalogy (5)
EEB 5134—Introduction to Ornithology (5)
EEB 5136—Ichthyology (4)
Ent 1005—Economic Entomology (4)
or Ent 5020—Insect Taxonomy (5)
FR 1100—Dendrology (4)
PBio 3201—Introductory Plant Systematics (4)

Group 3—Community and Ecosystem Ecology

Select one of the following:

EEB 5014—Ecology of Vegetation (5)
EEB 5016—Ecological Plant Geography (5)
EEB 5601—Limnology (4)
EEB 5608—Ecosystem Form and Function (4)
EEB 5652—Community and Ecosystem Processes (4)
FR 5142—Tropical Forest Ecology (4)

Group 4—Fisheries, Wildlife, and Conservation Biology

FW 3054—Biological Conservation: An Ecosystem Approach (3)
NRES 3100—Conservation of Biodiversity (4)
Itasca Summer Session—Any field course (5)
or FW 5600—Fisheries and Wildlife Field Techniques (Itasca) (4) and FW 3106—Important Plants in Fisheries and Wildlife Habitats (Itasca) (2)

Select one of the following:

FW 5601—Fisheries Population Analysis (4)
EEB 5051—Analysis of Populations (4)
FW 5603—Wildlife Habitats and Management (3)
FW 5604—Fisheries Ecology and Management (3)

Group 5—Miscellaneous Required Courses

LA 5202—Landscape Ecology (3)
Select one of the following:
FW 5620—Geographic Information Systems for Fisheries, Wildlife, and Biological Conservation (4)
or FR 5130—Geographic Information Systems in Natural Resources Analysis (3)
NRES 3575/5575—Wetlands Conservation (3)
Hort 5015—Restoration and Reclamation Ecology (4)

Electives—Select any course from the list below, from any of the three areas of specialization, or as approved by your adviser to total 192 credits for graduation with the B.S. degree.

NRES 3001—Colloquium in NRES: Exotic Animals and Plants (2)
NRES 5001—Colloquium in NRES: Aquatic Restoration (1)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)

Total graduation requirements—192 credits. Required core curriculum (115-130 credits), area of specialization courses (42-53 credits), and electives (9-35 credits).

Pre-Veterinary Medicine—Students may fulfill the minimum requirements for admission to the University's College of Veterinary Medicine and other colleges of veterinary medicine by completing a bachelor's degree in fisheries and wildlife within any of the three areas of specialization. Although the minimum requirements for admission to colleges of veterinary medicine may be completed in three years, admission is highly competitive. Completing a bachelor's degree in fisheries and wildlife provides students with additional academic skills and other career opportunities. Students must include the courses listed below in selecting their electives.

Chem 3301—Organic Chemistry I (4)
Chem 3305—Organic Chemistry Lab I (2)
Chem 3302—Organic Chemistry II (4)
VPB 3103—General Microbiology (5)

Fisheries and Wildlife Minor

This minor enables students in programs such as biology, communications, education, forestry, natural resources and environmental studies, and others to develop an understanding of the principles and practices of fisheries, wildlife, and conservation biology. An overview of fish and wildlife biology and natural history and general principles applied to managing animal populations and habitats is provided. Students interested in the minor should contact the CNR Office for Student Affairs.

Background Courses

Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Biol 3008—Ecology and Evolution (4)
or an ecology course
FW 1001—Orientation in Fisheries, Wildlife, and Conservation Biology (1)
or a natural resources orientation course

Core Courses

FW 3052—Introduction to Fisheries and Wildlife Conservation (3)

FW 5603—Wildlife Habitats and Management (3)

FW 5604—Fisheries Ecology and Management (3)

Select one of the following:

FW 5129—Mammalogy (5)

EEB 5134—Introduction to Ornithology (5)

EEB 5136—Ichthyology (4)

Select one of the following:

FW 3054—Biological Conservation: An Ecosystem Approach (3)

FW 5461—The Behavior of Fishes (3)

FW 5459—Fish Physiology (4)

FW 5570—Avian Conservation (4)

FW 5601—Fisheries Population Analysis (4)

NRES 3575/5575—Wetlands Conservation (3)

Honors Program

The Department of Fisheries and Wildlife offers an honors program to recognize and promote outstanding academic achievement. The heart of the program is completion of a research project, supervised by a faculty mentor. Students also participate in an honors seminar designed to expose them to a broad range of current topics in natural resource science. The honors experience culminates in a senior thesis, an oral presentation of the research project, and recognition at the college graduation ceremony.

Research Project and Honors Seminar—The objectives of the research project are for students to gain experience conducting research and acquire new information about the topic under investigation. A goal is to promote high quality research and students are encouraged to submit their results for publication in a professional journal, if warranted.

Honors program students participate in one honors seminar. This seminar may be held in conjunction with graduate student seminars so that honors students interact with graduate students as well as each other, or the seminar may be organized and arranged to cover special topics of interest to the honors students.

Admission Procedures—Students who plan to apply for admission to the honors program should take the honors biology sequence of Biol 1201-1202-1203 beginning in the fall of the freshman year. If another biology sequence has been taken, the student must demonstrate the equivalency between the substitute courses and the Biol 1201-1202-1203 series. At the end

of the sophomore year (after completion of 90 credits), students should complete an honors program application, available in 200 Hodson Hall.

Qualifications—A minimum GPA of 3.20 is required for admission. After admission, students must make continual progress toward achieving a GPA of 3.40, the minimum necessary to graduate with honors.

Graduation with Honors—Participation in the honors program is required for graduation with the traditional honors designations *cum laude*, *magna cum laude*, and *summa cum laude*. Candidates for graduation with honors must complete the following.

1. At least 60 credits in upper division courses (3xxx and 5xxx) at the University of Minnesota, Twin Cities campus.
2. Two quarters (six credits) of directed research (FW 5801H, 5802H) with the results reported in an acceptable honors thesis and as an oral seminar. Students may use research they conducted while participating in the Undergraduate Research Opportunities Program (UROP) if approved by their faculty mentor.
3. One quarter (one credit) of honors seminar (FW 5200H).
4. Graduate Record Examination (General Test and Biology Subject Test) results to be filed with the Department of Fisheries and Wildlife.
5. The last 90 credits of A-F registration with the minimum GPAs specified below. If a portion of those credits have been transferred from another institution, the proportion of residence credits with grades of A must at least equal the proportion of transfer credits with grades of A.
6. Transcripts of students graduating with honors will show one of the following:
Cum laude 3.40 GPA
Magna cum laude 3.60 GPA
Summa cum laude 3.80 GPA

Forest Products

This curriculum is for students interested in careers in developing, producing, marketing, and using the many products that flow from forests—paper, wood-based panels, lumber, and furniture as well as chemicals from wood. Coursework emphasizes chemical, physical, and mechanical properties of wood and the newest technologies for converting raw material into product. For more information, contact Joseph G. Massey, Department of Forest Products head (612/624-7459). More information about the department—its programs, faculty, and students—can be found on the Department of Forest Products World Wide Web Home page at <http://forestry.umn.edu/FP/ForP.html>.

Marketing

This forest products specialization is for students interested in the marketing, sales, and distribution of forest products. Technical emphasis is on the physical-mechanical nature of wood-based building materials, including lumber, plywood, fiberboard, particleboard, and newer composite products. In addition, coursework focuses on marketing principles and analysis, management science, computer applications, and economics. Career opportunities include purchasing and selling of all types of forest products at wholesale and retail levels, technical sales, product promotion, and specialized marketing research. For more information, contact Sheryl Bolstad, student adviser, (612) 624-4230, sbolstad@forestry.umn.edu.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the forest products—marketing curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Freshman and Sophomore Years—85 credits

Communication Skills

Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)

Mathematical Thinking

Math 1142—Short Calculus (5)
Stat 3011—Statistical Analysis (4)

Physical and Biological Sciences

Biol 1009—General Biology (5)
Chem 1001—General Principles of Chemistry (4)
Chem 1002—Elementary Organic Chemistry (4)
Phys 1041—Introductory Physics (5)
Phys 1042—Introductory Physics (5)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

ApEc 1101—Principles of Microeconomics (4)
ApEc 1102—Principles of Macroeconomics (4)
Jour 1001—Introduction to Mass Communication (4)
Psy 1001—Introduction to Psychology (5)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Additional required CNR freshman and sophomore courses

ForP 1001—Forest Products Orientation (1)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)

Junior Year—46-48 required credits

Acct 1050—Introduction to Financial Reporting (5)
BIE 3060—Professional Sales Education (3)
CSci 3102—Introduction to PASCAL Programming (4)
or CSci 3113—Introduction to Programming in C (4)
or NRES 1020—Information Technology in Natural Resources (2)
ForP 3300—Wood Industry Tours (2)
ForP 3303—Forest Products Marketing (3)
ForP 3305—Grading Standards and Product Performance (2)
ForP 3312—Building Materials Estimating (2)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties (3)
ForP 5303—Wood Deterioration (4)
ForP 5331—Undergraduate Seminar (2)
Mgmt 3001—Fundamentals of Management (4)
Mktg 3000—Principles of Marketing (4)
Mktg 3040—Buyer Behavior (3)
Acct 3001—Introduction to Management Accounting (4)

Senior Year—51-53 required credits

BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
BFin 3000—Finance Fundamentals (4)
ForP 5304—Wood Drying and Preservation Processes (4)
ForP 5307—Wood-Base Panel Technology (4)
ForP 5308—Wood Machining (3)
ForP 5355—Mechanics and Structural Design With Wood Products (4)
ForP 5356—Advanced Forest Products Marketing (3)
NRES 5240—Natural Resource Policy and Administration (3)
or FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
Jour 5251—Psychology of Advertising (4)
Mktg 3030—Sales Management (4)
Mktg 3080—Marketing Strategy (4)
Rhet 3562—Writing in Your Profession (4)

Directed Electives—at least two courses

Acct 5160—Financial Statement Analysis (4)
ForP 5412—A Systems Approach to Residential Construction (3)
Jour 5721—Mass Media and U.S. Society (4)

LM 3000—Introduction to Logistics (4)
LM 5020—Advanced Logistics Management (4)
Mgmt 3002—Psychology in Management (4)
Mktg 3050—Marketing Communications (4)
Mktg 3065—Retail Management (4)

Total Graduation Requirements—192 credits. Required core curriculum (182-186 credits); remaining diversified core curriculum, designated themes of liberal education, and electives (6-10 credits).

Production Management

This forest products specialization is for students interested in manufacturing, production management, product development, and industrial engineering careers in industries that manufacture lumber, panel products, millwork, furniture, and other wood products. In addition to a strong wood science background, students gain knowledge in industrial engineering, labor management and economics. For more information, contact Sheryl Bolstad, student adviser, (612) 624-4230, sbolstad@forestry.umn.edu.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the forest products—production management curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Freshman and Sophomore Years—88 credits

Communication Skills

Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)

Mathematical Thinking

Math 1251—One-Variable Differential and Integral Calculus I (4)
Math 1252—One-Variable Differential and Integral Calculus II (4)
Stat 3091—Probability and Statistics (4)

Physical and Biological Sciences

BioC 1401—Elementary Biological Chemistry I (4)
Biol 1009—General Biology (5)
Chem 1051—General Principles of Chemistry I (4)
Chem 1052—General Principles of Chemistry II (4)
Phys 1041—Introductory Physics (5)
Phys 1042—Introductory Physics (5)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

ApEc 1101—Principles of Microeconomics (4)
ApEc 1102—Principles of Macroeconomics (4)
Psy 1001—Introduction to Psychology (5)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Suggested courses:

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

Additional required CNR freshman and sophomore courses

ForP 1001—Forest Products Orientation (1)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)

Junior Year—40-42 required credits

CSci 3102—Introduction to PASCAL Programming (4)
or CSci 3113—Introduction to Programming in C (4)
or NRES 1020—Information Technology in Natural Resources (2)
ForP 3300—Wood Industry Tours (2)
ForP 3303—Forest Products Marketing (3)
ForP 3305—Grading Standards and Product Performance (2)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties of Wood (3)
ForP 5303—Wood Deterioration (3)
ForP 5331—Undergraduate Seminar (2)
ForP 5355—Mechanics and Structural Design With Wood Products (4)

IEOR 3000—Introduction to Industrial Engineering Analysis (4)

IEOR 5030—Quality Control and Reliability (4)
IEOR 5040—Introduction to Operations Research (4)
IR 3002—Personnel and Industrial Relations (4)

Senior Year—51-53 required credits

ForP 5304—Wood Drying and Preservation Processes (4)
ForP 5305—Pulp and Paper Technology (2)
ForP 5306—Analysis of Production Systems (3)
ForP 5307—Wood-Base Panel Technology (4)
ForP 5308—Wood Machining (3)
NRES 5240—Natural Resource Policy and Administration (3)
or FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
IEOR 5010—Introduction to Work Analysis (4)
IEOR 5020—Engineering Cost Accounting (4)
IEOR 5311—Management for Engineers (4)
IEOR 5361—Inventory and Production Control (4)
IR 3007—Collective Bargaining and Modern Labor Relations (4)
Rhet 3562—Writing in Your Profession (4)

Suggested Electives

Acct 1050—Introduction to Financial Reporting (5)
NRES 3202—Leadership and Management Skills Development (2)
ForP 5356—Advanced Forest Products Marketing (3)
ForP 5412—A Systems Approach to Residential Construction (3)
IEOR 5180—Applied Industrial Engineering (3-5)
IEOR 5221—Facilities Planning (4)
IEOR 5351—Analysis of Production Processes (4)
LAsk 1001—Becoming a Master Student (4)
LM 3000—Introduction to Logistics Management (4)
Mktg 3000—Principles of Marketing (4)
Mktg 3040—Buyer Behavior (4)
Mktg 3090—Marketing Topics: Industrial Marketing (4)
Rhet 3254—Advanced Public Speaking (4)

BACCALAUREATE PROGRAMS

Rhet 3266—Communication, Discussion in Small Group Decision Making (4)

Total Graduation Requirements—192 credits. Required core curriculum (170-173 credits); remaining diversified core curriculum, designated themes of liberal education, and electives (19-22 credits).

Paper Science and Engineering

This specialization provides in-depth training in mathematics, physics, chemistry, engineering, and wood and fiber science and technology. It also includes specialized pulp and paper and related engineering courses on the technology of the pulping and papermaking processes. Graduates find careers in process engineering, manufacturing operations, technical services, marketing, plant management, and research and development. For more information, contact Sheryl Bolstad, student adviser, (612) 624-4230, sbolstad@forestry.umn.edu.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the forest products—paper science and engineering curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Freshman and Sophomore Years—92 credits

Communication Skills

Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)

Mathematical Thinking

Math 1251—One-Variable Differential and Integral Calculus I (4)
Math 1252—One-Variable Differential and Integral Calculus II (4)
Math 1261—Algebra and Geometry of Euclidean Space (4)
Math 3261—Differential Equations with Linear Algebra (4)

Physical and Biological Sciences

Chem 1051—Chemical Principles I (4)
Chem 1052—Chemical Principles II (4)
Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Laboratory I (2)
Chem 3306—Elementary Organic Chemistry Laboratory II (2)
Phys 1251—General Physics I (4)
Phys 1252—General Physics II (4)
Phys 1253—General Physics III (4)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historic perspective.

ApEc 1102—Principles of Macroeconomics (4)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following:

literature, philosophical perspective, and visual or performing arts.

Additional required CNR freshman and sophomore courses

CSci 3201—Introduction to PASCAL Programming (4)
or CSci 3113—Introduction to Programming in C (4)
ForP 1001—Forest Products Orientation (1)
ForP 5331—Undergraduate Seminar (2)

Junior Year—50 required credits

CE 3400—Fluid Mechanics (4)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
ForP 3300—Wood Industry Tours (2)
ForP 3301—Industrial Internship (2)
ForP 5302—Wood Chemistry I (3)
ForP 5305—Pulp and Paper Technology (2)
ForP 5306—Analysis of Production Systems (3)
ForP 5310—Pulp and Paper Process Laboratory (3)
ForP 5311—Pulp and Paper Process Engineering Calculations I (4)
ForP 5312—Pulp and Paper Process Engineering Calculations II (4)
ForP 5315—Paper Engineering Laboratory (2)
ForP 5353—Wood Chemistry II (3)
ForP 5361—Adhesion and Adhesives (3)
ME 3301—Thermodynamics (4)
Stat 5021—Statistical Analysis (5)

Senior Year—35-36 required credits

Chem 5520—Elementary Physical Chemistry (3)
ForP 5313—Pulp and Paper Process Operations (4)
ForP 5314—Pulp and Paper Process Operations II: Paper Machine Operations, Finishing and Converting (3)
ForP 5316—Coated Product Development (2)
ForP 5318—Pulp and Paper Process Dynamics and Control (3)
ForP 5320—Biological and Environmental Science of Pulp and Paper (3)
ForP 5321—Material Science of Paper: Paper and Fiber Physics and Properties (4)
ForP 5359—Surface and Colloid Chemistry of Papermaking (3)
ME 5342—Heat Transfer (4)
NRES 5240—Natural Resource Policy and Administration (3)
or FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
Rhet 3562—Writing in Your Profession (4)

Suggested Electives

CE 5500—Analysis and Design of Water Supply Systems (4)
CE 5501—Analysis and Design of Wastewater Systems (4)
Chem 5521—Elementary Physical Chemistry (3)
ChEn 5001—Computational Methods in Chemical Engineering and Material Science (4)
ChEn 5101—Principles of Chemical Engineering I (4)
ChEn 5102—Principles of Chemical Engineering II (4)
ForP 5300—Wood-Fluid Relations (3)
ForP 5301—Mechanical Properties (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 Laboratory I (2)
ME 3702—Basic Measurements Laboratory II (2)
ME 5283—Industrial Instrumentation and Automatic Control (4)
Stat 5301—Designing Experiments (5)

Total Graduation Requirements—192 credits. Required core curriculum (177-178 credits); remaining diversified core curriculum, designated themes of liberal education, and electives (14-15 credits).

Wood Science

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

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the forest products—wood science curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Freshman and Sophomore Years—102 Credits

Communication Skills

Rhet 1101—Writing to Inform and Persuade (4)

Rhet 1104—Library Research Methods (1)

Rhet 1151—Writing in Your Major (4)

Mathematical Thinking

Math 1251—One-Variable Differential and Integral Calculus I (4)

Math 1252—One-Variable Differential and Integral Calculus II (4)

Math 1261—Algebra and Geometry of Euclidean Space (4)

Math 3251—Multivariable Differential Calculus (4)

Physical and Biological Sciences

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Chem 1051—Chemical Principles I (4)

Chem 1052—Chemical Principles II (4)

Chem 3301—Elementary Organic Chemistry I (4)

Chem 3302—Elementary Organic Chemistry II (4)

Chem 3305—Elementary Organic Chemistry Laboratory I (2)

Chem 3306—Elementary Organic Chemistry Laboratory II (2)

Physics 1251—General Physics I (4)

Physics 1252—General Physics II (4)

Physics 1253—General Physics III (4)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historic perspective.

ApEc 1101—Principles of Microeconomics (4)

ApEc 1102—Principles of Macroeconomics (4)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Additional required CNR freshman and sophomore courses

ForP 1001—Forest Products Orientation (1)

ForP 1301—Wood as a Raw Material (4)

ForP 1303—Wood Structure and Identification (2)

FR 1100—Dendrology (4)

Junior Year—33 required credits

Chem 3100—Quantitative Analysis Lecture (3)

Chem 3101—Quantitative Analysis Laboratory (2)

Chem 5520—Elementary Physical Chemistry (3)

ForP 3300—Wood Industry Tours (2)

ForP 5300—Wood-Fluid Relationships (3)

ForP 5301—Mechanical Properties (3)

ForP 5302—Wood Chemistry I (3)

ForP 5303—Wood Deterioration (4)

ForP 5331—Undergraduate Seminar (2)

Rhet 1222—Public Speaking (4)

Stat 3011—Statistical Analysis (4)

Senior Year—32 required credits

CSci 3102—Introduction to PASCAL Programming (4)

or CSci 3113—Introduction to Programming in C (4)

or AgET 3030—Introduction to Problem Solving With Computers (4)

ForP 5304—Wood Drying and Preservation Processes (4)

ForP 5305—Pulp and Paper Technology (4)

ForP 5306—Analysis of Production Systems (3)

ForP 5307—Wood-Base Panel Technology (4)

ForP 5353—Wood Chemistry II (3)

ForP 5355—Mechanics and Structural Design With Wood Products (4)

ForP 5361—Adhesion and Adhesives (3)

NRES 5240—Natural Resource Policy and Administration (3)

or FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)

Rhet 3562—Writing in Your Profession (4)

Total Graduation Requirements—192 credits. Required core curriculum (167 credits); remaining diversified core curriculum, designated themes of liberal education, and electives (25 credits).

Forest Resources

The forest resources curriculum prepares students to plan, implement, and research the management, protection, and sustainable use of forest and related resources, including timber, water, wildlife, recreation, and aesthetics. Forest resources students may select between two tracks, *forest management* and *forest science*. These tracks are similar in that both qualify students to be forest managers. However, students taking the forest management track receive more thorough training in principles and techniques of resource management, while those taking the forest science track receive more scientific or specialized training in particular aspects of forest resources.

Forest Management Track—This track is for students who wish to become directly involved in forest land management or find employment in specialized areas such as resource planning, forest protection, or policy development. Graduates may also pursue graduate study to become researchers and teachers or seek advanced positions in administering and managing forest and related natural resources.

Forest Science Track—This track is for students who wish to learn the fundamentals of forest resource management while gaining some depth

in a self-selected basic or applied science related to forest resources. Graduates might pursue careers as forest managers but more likely are considering graduate school followed by careers in research, teaching, and technical support for managers and administrators. Examples of areas of specialization include, quantitative methods, economics and policy, forest ecology, silviculture, watershed management/water resources, and resource protection.

Students following the forest management track must attend *both* the Itasca and Cloquet field sessions. Students following the forest science track must attend *either* the Itasca or Cloquet field session.

Forest Management and Forest Science Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the forest resources curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Communication Skills

- Comp 1011—Writing Practice I (5)
- or Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1122—Public Speaking (4)
- or Spch 1101—Fundamentals of Speech Communication: Oral Communication (4)

Select one of the following:

- Comp 1027—Intermediate Expository Writing (4)
- Comp 3014—Writing in the Social Sciences (4)
- Comp 3015—Writing About Science (4)
- Comp 3027—Advanced Expository Writing (4)
- Rhet 3151—Writing in Your Major (4)
- Rhet 3562—Writing in Your Profession (4)

Mathematical Thinking

- Math 1142—Short Calculus (5)
- or Math 1251, 1252—One Variable Differential and Integral Calculus I-II (4,4)¹
- Stat 3011—Statistical Analysis (4)
- or Stat 5021—Statistical Analysis (5)

Physical and Biological Sciences

- Bio 1009—General Biology (5)
- or similar basic biology course (5)
- Biol 1103—Botany (5)
- Chem 1001—Chemical Principles (4)
- and Chem 1002—Elementary Organic Chemistry (4)
- or Chem 1051, 1052—General Principles I-II (4,4)²
- Phys 1001—The Physical World (4)
- and Phys 1005—Physics Laboratory (1)
- Phys 1041—Introduction to Physics (5)
- Soil 1020—The Soil Resource (4)³
- or Soil 3125—Basic Soil Science (4)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including *one* course with historical perspective.

- ApEc 1101—Principles of Microeconomics (4)
- or Econ 1101—Principles of Microeconomics (4)
- ApEc 1102—Principles of Macroeconomics (4)
- or Econ 1102—Principles of Macroeconomics (4)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Forest Management Track Required Professional Courses

Introductory and General

- FR 1001—Forest Resources Orientation (1)
- ForP 1301—Wood as a Raw Material (4)
- NRES 1020—Information Technology in Natural Resources (2)

Resource Assessment

- FR 3201—Forest Measurement Techniques (Itasca) (1)
- FR 5262—Remote Sensing of Natural Resources (4)
- NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources (4)
- FR 5202—Remote Sensing Field Applications (Cloquet) (2)
- FR 5218—Assessment and Modeling of Forests (3)
- FR 5222—Forest Resources Inventory (Cloquet) (2)

Management of Vegetation, Wildlife, Soil, and Water

- FR 1100—Dendrology (4)
- FR 3100—Minnesota Plants (Itasca) (2)
- FR 3101—Northern Forest Ecosystems (Itasca) (3)
- FR 3103—Climatology and Meteorology for Natural Resource Managers (2)
- FR 3104—Forest Ecology (4)
- FR 5100—Silviculture (4)
- FR 5101—Field Silviculture (Cloquet) (4)
- FR 5102—Forest Wildlife Habitat Management (Cloquet) (1)
- FR 5114—Forest Hydrology and Watershed Management (4)
- FR 5115—Forest Hydrology: Field Applications (Cloquet) (2)
- FR 5126—Soil Site Relations (Cloquet) (2)
- FR 5248—Harvesting and Engineering (Cloquet) (3)
- FW 3052—Introduction to Fisheries and Wildlife Conservation (3)

Select two of the following:

- Ent 5250—Forest and Shade Tree Entomology (4)
- PIPa 5212—Diseases of Forest and Shade Trees (4)
- FR 5215—Forest Fire Ecology and Management (2)

Economics, Management, Policy, and Planning

- FR 5232—Management of Recreational Lands (4)
- FR 5236—Forest Recreation Planning (Cloquet) (1)
- NRES 5240—Natural Resources Policy and Administration (4)
- NRES 5260—Economics and Natural Resources Management (3)
- FR 5270—Forest Management and Planning (3)
- NRES 3202—Leadership and Management Skills Development (3)
- or NRES 5242—Management of Natural Resources Conflict (3)
- or IR 5001—Systems of Conflict and Dispute Resolution (4)
- or Rhet 3266—Communication Discussion in Small Group Decision Making (4)

Forest Management Track Field Sessions

Itasca Session—6 required credits (3 courses). Students should complete this 3½-week summer term offering between their freshman and sophomore or sophomore and junior years.

¹ Math 1251, 1252 recommended for forest science students.

² Chem 1251, 1252 recommended for forest science students interested in biophysical sciences.

³ Offered through UC/CEE only.

Cloquet Session—17 required credits (8 courses). Students should complete this 8-week session in the fall of their senior year.

Courses for both field sessions are listed under required professional courses and are identified as either Itasca or Cloquet.

Forest Management Professional Elective Courses—Twenty credits, approved by adviser, are required. A maximum of eight credits of alternative professional courses may be used to satisfy this requirement.

Group 1—Managing Plants, Animals, Soils, and Water

FR 5120—Tree Biology (3)
FR 5142—Tropical Forests (3-4)
FR 5152—Forest Genetics (3)
FR 5153—Advanced Forest Hydrology (4)
FR 5231—Range Management (3)
FW 5603—Wildlife Habitats and Management (3)
FW 5604—Fisheries Ecology and Management (3)
Geo 1001—Introduction to Geology (4)
Geo 1021—Introduction to Geology Laboratory (1)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
Soil 5710—Forest Soils (3)

The following courses may apply if they were not used to fulfill the core requirement:

Ent 5250—Forest and Shade Tree Entomology (4)
FR 5215—Forest Fire Ecology and Management (2)
NRES 3103—Climatology and Meteorology for Natural Resources Managers (2)
PIPa 5212—Diseases of Forest and Shade Trees (4)

Group 2—Resource Policy, Management, and Planning

FR 1201—Conservation of Natural Resources (3)
FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
FR 5264—Quantitative Techniques in Forest Management (3)
NRES 3010—Ethics and Values in Resource Management (3)
NRES 3202—Leadership and Management Skills Development (3)
NRES 5101—Integrated Natural Resources Planning (5)
NRES 5242—Management of Natural Resources Conflict (3)

Group 3—Assessment and Information Systems

FR 3300—Surveying (2)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5228—Advanced Topics in Resource Assessment and Modeling (4)
FR 5412—Advanced Remote Sensing (4)

Forest Management Track total graduation requirements—192 credits. Required core curriculum (72-77 credits); required professional courses (85-88 credits); professional electives (20 credits), and remaining diversified core curriculum, designated themes of liberal education, and electives (7-15 credits).

Forest Science Track Required Professional Courses

Introductory and General

FR 1001—Forest Resources Orientation (1)
NRES 1020—Information Technology in Natural Resources (2)

Resource Assessment

FR 5262—Remote Sensing of Natural Resources (4)
NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)
FR 5218—Assessment and Modeling of Forests (3)

Management of Vegetation, Wildlife, Soil, and Water

FR 1100—Dendrology (4)
FR 3103—Climatology and Meteorology for Natural Resource Managers (2)
FR 3104—Forest Ecology (4)
FR 5100—Silviculture (4)
FR 5114—Forest Hydrology and Watershed Management (4)
or NRES 3060/5060—Water Quality in Natural Resource Management (3)
FW 3052—Introduction to Fisheries and Wildlife Conservation (3)
Ent 5250—Forest and Shade Tree Entomology (4)
or PIPa 5212—Diseases of Forest and Shade Trees (4)

Economics, Management, Policy, and Planning

FR 5232—Management of Recreational Lands (4)
NRES 5240—Natural Resources Policy and Administration (4)
NRES 5260—Economics and Natural Resources Management (3)
FR 5270—Forest Management and Planning (3)

Forest Science Track Field Sessions—Forest science students must take either the Itasca or Cloquet field session.

Itasca Session—6 required credits. Students should complete this 3½-week session between their freshman and sophomore or sophomore and junior years.

FR 3100—Minnesota Plants (2)
FR 3101—Northern Forest Ecosystems (3)
FR 3201—Forest Management Techniques (1)

Cloquet Session—17 required credits. Students should complete this 8-week session in the fall of their senior year.

FR 5101—Field Silviculture (4)
FR 5102—Forest Wildlife Habitat Management (1)
FR 5115—Forest Hydrology: Field Applications (2)
FR 5126—Silviculture: Soil-Site Relationships (2)
FR 5202—Remote Sensing: Field Applications (2)
FR 5222—Forest Resources Inventory (2)
FR 5236—Forest Recreation Planning (1)
FR 5248—Harvesting and Engineering (3)

Forest Science Track Science Core—27 credits required. These courses are in addition to the diversified core curriculum and other requirements and should be approved by faculty advisers. Some of the courses listed under professional elective courses may also qualify as science core courses.

Forest Science Professional Elective Courses—Eleven credits, approved by adviser, are required for students taking the Itasca field session.

Group 1—Managing Plants, Animals, Soils, and Water

FR 5120—Tree Biology (3)
FR 5142—Tropical Forests (3-4)
FR 5152—Forest Genetics (3)
FR 5153—Advanced Forest Hydrology (4)
FR 5231—Range Management (3)
FW 5603—Wildlife Habitats and Management (3)
FR 5604—Fisheries Ecology and Management (3)
Geo 1001—Introduction to Geology (4)
Geo 1021—Introduction to Geology Laboratory (1)
NRES 3060/5060—Water Quality in Natural Resources Management (3)
Soil 5710—Forest Soils (3)

BACCALAUREATE PROGRAMS

The following courses may apply if they were not used to fulfill the core requirement:

- Ent 5250—Forest and Shade Tree Entomology (4)
- FR 5215—Forest Fire Ecology and Management (2)
- FR 3103—Meteorology and Climatology for Natural Resources Managers (2)
- PIPa 5212—Diseases of Forest and Shade Trees (4)

Group 2—Resource Policy, Management, and Planning

- FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
- FR 5264—Quantitative Techniques in Forest Management (3)
- NRES 1201—Conservation of Natural Resources (3)
- NRES 3010—Ethics and Values in Resource Management (3)
- NRES 3202—Leadership and Management Skills Development (3)
- NRES 5101—Integrated Natural Resources Planning (5)
- NRES 5242—Management of Natural Resources Conflict (3)

Group 3—Assessment and Information Systems

- FR 3300—Surveying (2)
- FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
- FR 5228—Advanced Topics in Resource Assessment and Modeling (4)
- FR 5412—Advanced Remote Sensing (4)

Group 4—Field Session Courses

The Itasca field session may be used to satisfy Group 4 if it was not taken to fulfill the field session requirement. The Itasca session consists of three courses taken as a package while the Cloquet session courses may be taken individually if a student has already attended the Itasca field session.

Forest Science Track total graduation requirements—192 credits. Required core curriculum (72-77 credits); required professional courses (69-70 credits for students attending the Cloquet field session, 58-59 credits plus 11 credits of professional electives for students attending the Itasca field session); science core (27 credits); and remaining diversified core curriculum, designated themes of liberal education, and electives (18-24 credits).

Forest Harvesting—This option in the forest management or forest science track is for students interested in timber harvesting and its impact on other resource management considerations. The coursework is interdisciplinary and requires careful preparation for spending the senior year at the University of Idaho earning 14 semester credits (21 quarter credits). Students are trained for careers in logging engineering firms, forest products companies, and government agencies. Typical work includes planning and designing timber sales, supervising logging crews, designing and laying out roads, and managing wood procurement.

Students follow the forest management or forest science track the first three years, taking courses to meet University of Idaho prerequisites. Suggested courses are shown below. For more information, contact Dr. Charles R. Blinn, 314 Green Hall (612/624-3788).

Junior Year

- CE 3100—Introduction to Surveying and Mapping (4)*
or FR 3300—Elements of Surveying (Cloquet) (2)
- FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
- FR 3104—Forest Ecology (4)
- FR 5218—Assessment and Modeling of Forests (3)
- NRES 5260—Economics and Natural Resources Management (3)
- FR 5262—Remote Sensing (4)
- FW 3052—Introduction to Fisheries and Wildlife Conservation (3)
- FR 5100—Silviculture (4)
- NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)
- NRES 5240—Natural Resource Policy and Administration (3)
- Rhet 3562—Writing in Your Profession (4)
- FR 5214—Forest Hydrology (4)
- FR 5231—Range Management (3)

* *Students need override from the Department of Civil Engineering to register.*

Senior Year

Fall Quarter (Cloquet Session)—17 credits

Spring Semester (Idaho)—6 or 9 semester credits

- For Pr 431—Production and Cost Control in Timber Harvesting (3 sem/4.5 qtr cr; offered alt yrs)
- 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; taught as directed study alt yrs)*

Fall Semester (Idaho)—5 or 8 semester credits

- For Pr 430—Forest Engineering and Harvesting (3 sem/4.5 qtr cr)
- For Pr 432—Low-Volume Forest Roads (3 sem/4.5 qtr cr)
- For 470—Introduction to Forest Resources Planning (3 sem/4.5 qtr cr; offered spring)

Recommended Electives (Idaho)

- Bus 332—Quantitative Methods in Business (3 sem/4.5 qtr cr; offered fall/spring)
- CE 316—Advanced Route Surveying (2 sem/3 qtr cr; offered spring alt yrs)
- CE 482—Project Management Techniques (1-4 sem/1.5-6 qtr cr; offered spring)
- For 476—Forestry Project Evaluation (3 sem/4.5 qtr cr; offered fall)
- For 477—Integrated Forest Management Models (3 sem/4.5 qtr cr; offered spring)
- For 575—Advanced Forest Management (2 sem/3 qtr cr; offered alt yrs)
- For Pr 522—Advanced Forest Roads (3 sem/4.5 qtr cr; offered spring alt yrs)
- For Pr 534—Advanced Techniques of Timber Harvesting (3 sem/4.5 qtr cr; offered spring alt yrs)

* *To be taken only once, during spring semester or as directed study in fall semester.*

Urban Forestry

The urban forestry curriculum prepares students to plan and manage vegetation and associated natural resources in and near urban and rural communities. This typically includes consideration of forest, water, wildlife, and recreational and aesthetic values. The curriculum

prepares students for direct involvement in resource management or for specialized supporting roles in areas such as urban planning and environmental education. Biological and managerial sciences are emphasized.

Urban forests include areas along streets and in parks, transportation right-of-ways, private lands, 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 principle employers, as well as state and federal forestry agencies, forest and arboricultural consulting firms, nurseries, and utility companies. Graduates may also be qualified for traditional forestry positions, including those in the federal government.

All urban forestry students take the same required core curriculum. In addition, students working with their adviser select professional electives to increase competence either in the technical or social managerial aspects of urban forestry. Those going into consulting or private business emphasize the technical aspects. Those interested in managing the urban landscape will emphasize the managerial and sociopolitical aspects.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the urban forestry curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Communication Skills

- Comp 1011—Writing Practice (5)
 - or Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1122—Public Speaking (4)
 - or Spch 1101—Fundamentals of Speech-Communications: Oral Communication (4)

Select two of the following:

- Comp 1027—Intermediate Expository Writing (4)
- Comp 3014—Writing in the Social Sciences (4)
- Comp 3015—Writing About Science (4)
- Comp 3027—Advanced Expository Writing (4)
- Rhet 3151—Writing in Your Major (4)
- Rhet 3562—Writing in Your Profession (4)

Select one of the following:

- Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
- Spch 3411—Small Group Communication Processes (4)

Mathematical Thinking

- Math 1142—Short Calculus (5)
 - or Math 1251, 1252—One-Variable Differential and Integral Calculus I-II (4,4)
- Stat 3011—Statistical Analysis (4)
 - or Stat 5021—Statistical Analysis (4)

Physical and Biological Sciences

- Biol 1009—General Biology (5)
 - or similar basic biology course (5)
- Biol 1103—Botany (5)
- Chem 1001—General Principles of Chemistry (4)
 - and Chem 1002—Elementary Organic Chemistry (4)
- Phys 1001—The Physical World (4)
 - and Phys 1005—Physics Laboratory (1)
 - or Physics 1041—Introductory Physics (5)
- Soil 1020—The Soil Resource (5)*
 - or Soil 3125—Basic Soil Science (4)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

- ApEc 1101—Principles of Microeconomics (4)
 - or Econ 1101—Principles of Microeconomics (4)
- ApEc 1102—Principles of Macroeconomics (4)
 - or Econ 1102—Principles of Macroeconomics (4)
- Pol 1011—American Government and Politics (5)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

* Offered through UC/CEE only.

Required Professional Courses

Introductory and General

- FR 1001—Forest Resources Orientation (1)
- NRES 1020—Information Technology in Natural Resources (2)

Resource Assessment

- FR 3201—Forest Measurement Techniques (Itasca) (1)
- NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)
- FR 5262—Remote Sensing of Natural Resources (4)
- FR 5130—Geographic Information Systems in Natural Resource Analysis (3)

Management of Vegetation, Wildlife, Soil, and Water

- FR 1100—Dendrology (4)
 - or Hort 1021—Woody Plant Materials (5)
- FR 3100—Minnesota Plants (Itasca) (2)
- FR 3101—Northern Forest Ecosystems (Itasca) (3)
- FR 3104—Forest Ecology (4)
- FR 3500—Arboriculture (3)
- FR 5100—Silviculture (4)
- FR 5114—Forest Hydrology and Watershed Management (4)
 - or NRES 3060/5060—Water Quality in Natural Resources Management (3)
- FR 5120—Tree Biology (3)
- FR 5500—Urban Forest Management (4)
- Ent 5250—Forest Entomology (4)
- PIPa 5212—Forest and Shade Tree Pathology (4)

Economics, Management, and Policy

- FR 5232—Management of Recreational Lands (4)
- NRES 5240—Natural Resources Policy and Administration (3)
- NRES 5260—Economics and Natural Resources Management (3)
- UrbS 3104—Introduction to Urban Studies (4)

Required Professional Elective Courses—Twenty credits, approved by adviser, are required. A maximum of eight credits of alternative professional courses may be used to satisfy this requirement.

Group 1—Technical

- ForP 1301—Wood as a Raw Material (4)
- FW 3052—Introduction to Fisheries and Wildlife Conservation (3)
- FW 5603—Wildlife Habitats and Management (3)
- Hort 1036—Plant Propagation (5)
- Hort 3001—Growth Regulation of Horticulture Plants (5)
- Hort 3002—Horticultural Cropping Systems (5)
- Hort 3030—Landscape Design of Residential and Small Commercial Sites (4)
- Hort 5046—Nursery Management I (4)*
and Hort 5047—Nursery Scheduling and Enterprise Development (2)
and Hort 5048—Nursery Management II (4)
- Soil 3416—Plant Nutrients in the Environment (4)
- Stat 3012—Statistics (4)

* No grade will be assigned for these three courses (Hort 5046, 5047, 5048) unless all three are completed.

Group 2—Managerial and Sociopolitical

- ApEc 5630—Regional Development Systems (3)
- Anth 5117—Natural Resources Anthropology (4)
- FR 5233—Principles of Outdoor Recreation Planning (3)
- Geo 1402—Geography and Environmental Systems (5)
- LA 1401—The Designed Environment (4)
- NRES 1201—Conservation of Natural Resources (3)
- NRES 3001—Colloquium in Natural Resources and Environmental Studies (1-2)
- NRES 3010—Ethics and Values in Resource Management (3)
- NRES 3202—Leadership and Management Skills Development (3)
or NRES 5242—Management of Natural Resources Conflict (3)
- Soc 1001—Introduction to Sociology (4)
- Soc 3601—Urban Community (4)
- Spch 3451—Intercultural Communication: Theory and Practice (4)

Total graduation requirements—192 credits. Required core curriculum (81-86 credits); required professional courses (69-70 credits); required professional electives (20 credits); and remaining diversified core curriculum, designated themes of liberal education, and electives (16-22 credits).

Recreation Resource Management

The recreation resource management curriculum prepares students for comprehensive planning and management of land and water for recreation, with emphasis on natural and managed nonurban areas; administration of natural resources-oriented recreation programs in public and private sectors; and graduate study. Understanding social science aspects of natural resources use and developing skills in communications and planning are emphasized.

Graduates may become directly involved in recreation resource management or play

specialized supporting roles in areas such as planning and public relations. Still others find employment in related fields such as environmental education and interpretation. Students pursuing graduate study may develop careers in teaching and/or research or seek advanced positions in recreation resource management and administration.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the recreation resource management curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Communication Skills

- Comp 1011—Writing Practice (5)
or Rhet 1101—Writing to Inform and Persuade (4)

Select two of the following:

- Comp 1027—Intermediate Expository Writing (4)
- Comp 3014—Writing in the Social Sciences (4)
- Comp 3015—Writing About Science (4)
- Comp 3027—Advanced Expository Writing (4)
- Rhet 3151—Writing in Your Major (4)
- Rhet 3562—Writing in Your Profession (4)

Select one of the following:

- Rhet 1122—Public Speaking (4)
- Spch 1101—Fundamentals of Speech Communication: Oral Communication (4)

Select one of the following:

- Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
- Rhet 3254—Advanced Public Speaking (4)
- Spch 3411—Small Group Communication Processes (4)

Mathematical Thinking

- Math 1142—Short Calculus (5)
- Stat 3011—Statistical Analysis (4)
and Stat 3012—Statistical Analysis (4)
or Stat 5021—Statistical Analysis (5)

Physical and Biological Sciences

- Biol 1009—General Biology (5)
or similar basic biology course (5)
- Biol 1103—Botany (5)
- Chem 1001—General Principles of Chemistry (4)
- Chem 1002—Elementary Organic Chemistry (4)
- Geo 1001—Introduction to Geology (4)
- Geo 1021—Introduction to Geology Laboratory (1)
- Soil 1020—The Soil Resource (4)*
or Soil 3125—Basic Soil Science (4)

* Offered through UC/CEE only.

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

- ApEc 1101—Principles of Microeconomics (4)
or Econ 1101—Principles of Microeconomics (4)
- ApEc 1102—Principles of Macroeconomics (4)
or Econ 1102—Principles of Macroeconomics (4)

Select one of the following three groups:

- Psy 1001—Introduction to Psychology (4)
and Psy 3201—Introduction to Social Psychology (5)
- or Soc 1001—Introduction to Sociology (4)
and Soc 3401—Principles of Social Organization (4)
- or Soc 1001—Introduction to Sociology (4)
and Soc 3411—Understanding Formal Organizations (4)

Arts and Humanities—Minimum of three courses totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

LA 1401—The Designed Environment (4)

Additional Recreation Resource Management Core Courses
Anth 5117—Natural Resources Anthropology (4)

Required Professional Courses

Introductory and General

- FR 1001—Forest Resources Orientation (1)
or NRES 1001—Natural Resources Orientation (1)
- NRES 1201—Conservation of Natural Resources (3)
or NRES 1040—Natural Resources as Raw Materials (3)
- NRES 1020—Information Technology in Natural Resources (2)
- NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)

Resource Assessment

- NRES 5210 Survey, Measurement, and Modeling Methods for Natural Resources I (4)
- FR 5130—Geographic Information Systems in Natural Resources Analysis (3)

Management of Vegetation, Wildlife, Soil, and Water

- FR 1100—Dendrology (4)
- FR 3104—Forest Ecology (4)
or Biol 3008—Ecology and Evolution (4)
- FR 5114—Forest Hydrology and Watershed Management (4)
or NRES 3060/5060—Water Quality in Natural Resource Management (3)
- NRES 3020/5020—Plant Resource Management and the Environment (4)
or FR 5100—Silviculture (4)
- FW 3052—Introduction to Fisheries and Wildlife Conservation (3)

Management, Policy, and Planning

- FR 5232—Management of Recreational Lands (4)
- FR 5257—Recreation Land Policy (3)
- FR 5259—Analysis of Outdoor Recreation Behavior (3)
- NRES 3010—Ethics and Values in Resource Management (3)
- NRES 5100—Interdisciplinary Problem Solving (5)
- NRES 5245—Fundamentals of Landscape Planning for Recreation (3)
- NRES 5800—Natural Resources Interpretation and Communication (3)
- Rec 3530—Recreation and Park Areas and Facilities (4)
or Rec 3550—Park and Recreation Administration (4)
- Rec 5750—Legal Issues in Leisure Services (4)
or NRES 5242—Management of Natural Resources Conflict (3)

Required Professional Elective Courses

Select one course from each of the following.

Group 1—Social and Managerial Sciences

- ApEc 5620—Regional Economic Analysis (3)
- Geog 5393—Look of the Land (4)
- NRES 3202—Leadership and Management Skills Development (3)
- NRES 5101—Integrated Natural Resource Planning (5)

- NRES 5240—Natural Resource Policy and Administration (3)
- NRES 5242—Management of Natural Resources Conflict (3)
- NRES 5260—Economics and Natural Resources Management (5)

- Psy 5202—Attitudes and Social Behavior (4)
- Soc 5305—Environmental Sociology (3)

Group 2—Recreation, Programming, and Management Services

- Rec 5190—Commercial Recreation (3)
- Rec 5250—Financing Leisure Services (3)
- Rec 5310—Programming in Outdoor Recreation (4)
- Rec 5350—Wilderness Outdoor Recreation (4)

Group 3—Management of Vegetation, Soil, and Water

- EEB 5016—Ecological Plant Geography (5)
- EEB 5608—Ecosystems: Form and Function (4)
- NRES 3200—Field Ecology (Itasca) (4)
or FR 3101—Northern Forest Ecosystems (3)
and FR 3100—Minnesota Forest Plants (Itasca) (2)
and FR 3201—Forest Measurement Techniques (Itasca) (1)

LA 5202—Landscape Ecology (3)

Total graduation requirements—192 credits. Required core curriculum (89-94 credits); required professional courses (63-65 credits); required professional electives (9-15 credits); and remaining diversified core curriculum, designated themes of liberal education, and electives (18-31 credits).

Forest Resources Minor

This minor helps students in natural resources or related areas to develop a solid understanding of forest resource dynamics and management and the importance of forest resources in our society. The minor incorporates a fundamental science background plus coursework 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—15 credits

- FR 1100—Dendrology (4)
- NRES 1201—Conservation of Natural Resources (3)
- FR 3104—Forest Ecology (4)*
or Biol 3008—Ecology and Evolution (4)
- FR 5100—Silviculture (4)

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

Optional Courses—10 credits, with at least one course from each of the following categories:

Management and Policy

- ForP 1301—Wood as a Raw Material (4)
- FR 3201—Forest Measurements Techniques (1)
- FR 3250/5250—Role of Renewable Natural Resources in Developing Countries (2)
- FR 5130—Geographic Information Systems in Natural Resources Analysis (3)

FR 5262—Remote Sensing (4)
 FR 5218—Assessment and Modeling of Forests (3)
 FR 5202—Remote Sensing: Field Applications (2) (Cloquet)
 FR 5222—Forest Resources Inventory (2) (Cloquet)
 FR 5214—Forest Hydrology (4)
 FR 5231—Range Management (3)
 FR 5232—Management of Recreational Lands (4)
 FR 5236—Forest Recreation Planning (1) (Cloquet)
 FR 5248—Harvesting and Engineering (3) (Cloquet)
 FR 5264—Quantitative Techniques in Forest Management (3)
 FR 5270—Forest Management and Planning (3)
 FR 5500—Urban Forest Management (4)
 NRES 5240—Natural Resource Policy and Administration (3)

Biology

Ent 5250—Forest Entomology (4)
 FR 3500—Aboriculture (3)
 FR 3100—Minnesota Plants (Itasca) (1)
 FR 3101—Northern Forest Ecosystems (Itasca) (3)
 FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
 FR 5101—Field Silviculture (4) (Cloquet)
 FR 5114—Forest Hydrology and Watershed Management (4)
 FR 5115—Forest Hydrology, Field Applications (Cloquet) (2)
 FR 5120—Tree Biology (3)
 FR 5126—Silviculture: Soil-Site Relationships (Cloquet) (2)
 FR 5142—Tropical Forest Ecology (3)
 FR 5152—Forest Genetics (3)
 FR 5153—Advanced Forest Hydrology (4)
 FR 5215—Forest Fire Ecology and Management (2)
 NRES 3060/5060—Water Quality in Natural Resource Management (3)
 PIPa 5212—Diseases of Forest and Shade Trees (4)

Natural Resources and Environmental Studies

The natural resources and environmental studies curriculum is for students interested in an interdisciplinary major focusing on the use and management of natural resources and the study of the environment.

Students have considerable flexibility in designing their study program. Programs can be designed to achieve one or more of the following objectives:

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

protection, sustainable development, policy analysis, waste management, and natural resource management.

- Develop appropriate background for graduate study.

All students take the core curriculum of required courses (including two colloquia) listed below. In addition, a minimum of 24 credits in an area of concentration is required. Areas of concentration are listed below. Courses should be selected in collaboration with the student's adviser. Course selection is critical because it helps define career direction and opportunities.

Required Core Curriculum

Note: Some of the required core curriculum courses also fulfill diversified core curriculum and designated themes requirements. Refer to the natural resources and environmental studies curriculum sheet and quarterly *Class Schedule* when selecting coursework.

Freshman and Sophomore Years—91-93 credits

Communication Skills

Rhet 1101—Writing to Inform and Persuade (4)
 Rhet 1104—Library Research Methods (1)
 Rhet 1151—Writing in Your Major (4)
 Rhet 1222—Public Speaking (4)

Mathematical Thinking

Math 1142—Short Calculus (5)
 or Math 1251, 1252—One-Variable Differential and Integral Calculus (4,4)
 Stat 3011—Statistical Analysis (4)

Physical and Biological Sciences

Biol 1009—General Biology (5)
 Biol 1103—Botany (5)
 or Biol 1106—General Zoology (5)
 Chem 1051, 1052—Chemical Principles I-II (4,4)
 or Chem 1001—General Principles of Chemistry (4)
 and Chem 1002—Elementary Organic Chemistry (4)
 Geo 1001—Introduction to Geology (4)
 and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
 Phys 1041—Introductory Physics (5)
 or Phys 1001, 1005—The Physical World (4,1)

History and Social Sciences—Minimum of three courses totaling at least 12 credits, including one course with historical perspective.

ApEc 1101—Principles of Microeconomics (4)
 or Econ 1101—Principles of Microeconomics (4)
 ApEc 1102—Principles of Macroeconomics (4)
 or Econ 1102—Principles of Macroeconomics (4)

Arts and Humanities—Minimum of three totaling at least 12 credits, including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

Additional required CNR freshman and sophomore courses

- NRES 1001—Orientation to Natural Resources and Environmental Studies (1)
NRES 1020—Information Technology in Natural Resources (2)
NRES 1040—Natural Resources as Raw Materials (3)
 or FR 3250—Role of Renewable Natural Resources in Developing Countries (2)
NRES 1201—Conservation of Natural Resources (3)
NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)*
NRES 3010—Ethics and Values in Resource Management (3)
Pol 1001—Political Science (5)

* Two (1 credit each) colloquia are required.

Junior and Senior Year—68-74 credits, including minimum of 24 credits in area of concentration.

- FR 3104—Forest Ecology (4)
 or Biol 3008—Ecology and Evolution (4)
FR 5103—Meteorology and Climatology for Natural Resource Managers (2)
 or Soil 1425—Introduction to Meteorology (4)
FR 5114—Forest Hydrology and Watershed Management (4)
 or NRES 3060/5060—Water Quality in Natural Resource Management (3)
FW 3054—Biological Conservation: An Ecosystem Approach (3)
NRES 3020/5020—Plant Resource Management and the Environment (4)
 or FR 5100—Silviculture (4)
NRES 5100—Problem Solving in Natural Resources and Environmental Studies (4)
NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (4)
NRES 5240—Natural Resource Policy and Management (3)
NRES 5260—Economics and Natural Resources Management (3)
Rhet 3562—Writing in Your Profession (4)
Soil 1020—The Soil Resource (4)*
 or Soil 3125—Basic Soil Science (4)
Soil 3220—Soil Conservation and Land Management (4)
 or Soil Physical Properties and the Environment (4)
 or Soil 5510—Field Study of Soil for Environmental Assessment (4)

* Offered through UC/CEE only.

Total graduation requirements—180 credits. Required core curriculum (135-143); area of concentration (24 credits minimum); and remaining diversified core curriculum, designated themes of liberal education and electives (13-21).

Areas of Concentration—
24 credits minimum

Environmental Issues and Planning—Focus on major issues in natural resources and the environment at local, national, and worldwide levels. Emphasis on understanding, analysis, planning, and decision making required to address these issues. For more information, contact Dr. Dorothy H. Anderson, 301F Green Hall, (612) 624-2721, danderso@forestry.umn.edu; Dr. Melvin J. Baughman, 330G Green Hall, (612) 624-0734, mbaughma@forestry.umn.edu; Dr. Francesca J. Cuthbert, 320 Hodson Hall, (612)

624-1756, cuthb001@maroon.tc.umn.edu; Dr. Paul V. Ellefson, 330B Green Hall, (612) 624-3735, pellefso@forestry.umn.edu; Dr. Howard M. Hoganson, North Central Experiment Station, Grand Rapids, MN 55744 (218) 327-4490; Dr. Peter A. Jordan, 201C Green Hall, (612) 624-9281, pjordan@forestry.umn.edu; Dr. Anne Kapuscinski, 130 Hodson Hall, (612) 624-2720, akapusci@forestry.umn.edu; Dr. David W. Lime, 301G Green Hall, (612) 624-2250, dlime@forestry.umn.edu; or Dr. Dietmar W. Rose, 301H Green Hall, (612) 624-9711, drose@forestry.umn.edu.

- ApEc 3040—Economic Development of American Agriculture (4)
ApEc 3610—Resource Development and Environmental Economics (4)
ApEc 5650—Economics of Natural Resource Policy (4)
FR 3104—Forest Ecology (4)
 or EEB 3001—Introduction to Ecology (4)
Econ 5611—Resource and Environmental Economics (4)
FR 5232—Management of Recreation Lands (4)
FR 5130/5131—Geographic Information Systems and Laboratory (3)
FR 5257—Recreation Land Policy (3)
FW 5460—Pollution Impacts on Aquatic Systems (2)
FW 5603—Wildlife Habitats and Management (3)
FW 5604—Fisheries Ecology and Management (3)
Geog 3361—Land Use and The Federal Government (4)
Geog 3362—Land Use and State Government (4)
Geog 5361—The Geography of Land Ownership (4)
Geog 5444—Water Resources, Individuals and Institutions (4)
Geog 5601—Introduction to Land Use Planning (4)
NRES 5101—Integrated Natural Resource Planning (5)
NRES 5242—Management of Natural Resources Conflict (3)
NRES 5245—Fundamentals of Landscape Planning for Recreation (3)
Pol 3872—International Organizations and the Environment (4)
Pol 5523—Politics of the Regulatory Process (4)

Environmental Learning—Focus on skills and knowledge for working in a variety of information and education fields associated with natural resources and the environment. Emphasis on environmental issues at local, regional, and global levels; the human dimensions of environmental education; and “best practices” for diverse audiences and teaching and learning in nonformal settings. For more information, contact Dr. Dorothy H. Anderson, 301 Green Hall, (612) 624-2721, danderso@forestry.umn.edu; Dr. Melvin J. Baughman, 330G Green Hall, (612) 624-0734, mbaughma@forestry.umn.edu; Dr. Stephan P. Carlson, 340 Coffey Hall, (612) 626-1259, carls009@maroon.tc.umn.edu; Dr. James A. Cooper, 110 Hodson Hall, (612) 624-4228, jcooper@forestry.umn.edu; Dr. James R. Kitts,

220 Hodson Hall, (612) 624-3000, jkitts@forestry.umn.edu; or Dr. Steven B. Laursen, 235 NRAB, (612) 624-9298, slaursen@forestry.umn.edu.

AgET 5027—Appropriate Technology in International Development (3)
 Agro 5200—World Food Problems (3)
 AnPl 3010—Environment and World Food Production (4)
 Anth 3116—Ecological Anthropology (3)
 CI 5537—Principles of Environmental Education (3)
 EPsy 5115—Psychology of Adult Learning (3)
 FR 5257—Recreation Land Policy (3)
 FR 5259—Analysis of Outdoor Recreation Behavior (3)
 FR 5403—Fundamentals of Natural Resource Education (1-3)
 HSci 3812—Introduction to History of Science: Scientific Revolution (4)
 NRES 3070—From Local to Global Ecology (3)
 NRES 5242—Management of Natural Resources Conflict (3)
 NRES 5245—Fundamentals of Land Use Planning for Recreation (3)
 NRES 5800—Natural Resources Interpretation and Communication (3)
 PIPa 3004—Air Pollution, People, and Plants (3)
 Pol 3872—International Organizations and the Environment (4)
 Rec 5300—Adventure Education (3)
 Rec 5310—Programming in Outdoor Education (4)
 Rhet 3395—In Search of Nature (3)

Resource Assessment—Focus on development of skills for assessing the magnitude and quality of various natural and environmental resources with techniques such as remote sensing, quantitative analysis, and geographic information systems. For more information, contact Dr. Marvin E. Bauer, 220B Green Hall (612) 624-3703, mbauer@forestry.umn.edu; Dr. Paul V. Bolstad, 209D Green Hall, (612) 625-1703, pbolstad@forestry.umn.edu; Dr. Thomas E. Burk, 301B Green Hall, (612) 624-6741, tburk@forestry.umn.edu; or Dr. Alan R. Ek, 115C Green Hall, (612) 624-3400, aek@forestry.umn.edu.

ApEc 3040—Economic Development of American Agriculture (4)
 ApEc 3610—Resource Development and Environmental Economics (4)
 Econ 5611—Resource and Environmental Economics (4)
 FR 3104—Forest Ecology (4)
 or EEB 3001—Introduction to Ecology (4)
 FR 3300—Elements of Surveying (2)
 FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
 FR 5218—Assessment and Modeling of Forests (3)
 FR 5228—Advanced Topics in Resource Assessment and Modeling (4)
 FR 5231—Range Management (3)
 FR 5232—Management of Recreational Lands (4)
 FR 5245—Fundamentals of Landscape Planning for Recreation (3)
 FR 5262—Remote Sensing of Natural Resources (4)
 FR 5412—Advanced Remote Sensing (4)

FR 5500—Urban Forest Management (4)
 FW 5460—Pollution Effects on Aquatic Systems (2)
 FW 5603—Wildlife Habitats and Management (3)
 FW 5604—Fisheries Ecology and Management (3)
 FW 5620—Geographic Information Systems for Fisheries, Wildlife, and Biological Conservation (4)
 Geog 5562—Introduction to Geographic Information Systems (4)
 Hort 5015—Restoration and Reclamation Ecology (4)
 NRES 3060/5060—Water Quality in Natural Resource Management (3)
 NRES 5101—Integrated Natural Resource Planning (5)
 NRES 5220—Survey, Measurement, and Modeling Methods for Natural Resources II (4)
 NRES 5242—Management of Natural Resources Conflict (3)
 NRES 5245—Fundamentals of Landscape Planning for Recreation (3)
 Soil 5020—Environmental Impact Assessment (4)
 Soil 5510—Field Study of Soils: Morphology (1)
 Soil 5511—Field Study of Soils: Mapping (1)
 Soil 5515—Soil Development Classification and Geography (4)
 Soil 5550—Peatlands Formation, Classification, and Utilization (3)
 Stat 5302—Applied Regression Analysis (5)

Resources and Environmental Protection—

Focus on understanding major environmental protection issues and their solutions. Topical concerns include solid waste management, global climate change, and protection of plant and animal resources. For more information, contact Dr. Ira R. Adelman, 200 Hodson Hall, (612) 624-3600, iadelman@forestry.umn.edu; Dr. Glenn R. Furnier, 101E Green Hall, (612) 624-3720, gfulnier@forestry.umn.edu; Dr. Hans M. Gregersen, 301D Green Hall, (612) 624-6298, hgregers@forestry.umn.edu; Dr. Anne Kapuscinski, 130 Hodson Hall, (612) 624-2720, akapusci@forestry.umn.edu; Dr. James R. Kitts, 216 Hodson Hall, (612) 624-3298, jkitts@forestry.umn.edu; Dr. Carl A. Mohn, 105 Green Hall, (612) 624-7281, cmohn@forestry.umn.edu; Dr. James A. Perry, 312 Green Hall, (612) 624-9796, jperry@forestry.umn.edu; Dr. Dietmar W. Rose, 301H Green Hall, (612) 624-9711, drose@forestry.umn.edu; or Dr. Edward I. Sucoff, 103 Green Hall, (612) 624-7249, esucoff@forestry.umn.edu.

ApEc 5600—Land Economics (3)
 Econ 5611—Research and Environmental Economics (4)
 FR 3104—Forest Ecology (4)
 or EEB 3001—Introduction to Ecology (4)
 FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
 FR 5262—Remote Sensing of Natural Resources (4)
 FW 5460—Pollution Impacts on Aquatic Systems (2)
 FW 5570—Avian Conservation (1-2)
 FW 5603—Wildlife Habitats and Management (3)
 FW 5604—Fisheries Ecology and Management (3)

FW 5620—Geographic Information Systems for Fisheries, Wildlife, and Biological Conservation (4)
 Geo 5108—Advanced Environmental Geology (4)
 Hort 5015—Restoration and Reclamation Ecology (4)
 NRES 3060/5060—Water Quality in Natural Resource Management (3)
 Pol 3872—International Organizations and the Environment (4)
 Pol 5523—Politics of the Regulatory Process (4)
 PubH 5181—Air Pollution (3)
 PubH 5253—Introduction to Hazardous Waste Management (3)*
 Soil 3416—Soil Fertility (5)

* Offered through UC/CEE only

Soil Resources—Focus on management, interpretation, and inventory of soil resources. Emphasis on preventing soil erosion and reducing land degradation and adverse impacts of erosion on water and air quality. For more information, contact Dr. Edward I. Sucoff, 103 Green Hall, (612) 624-7249, esucoff@forestry.umn.edu.

FR 5262—Remote Sensing in Natural Resources (4)
 FR 5114—Forest Hydrology and Watershed Management (4)
 or NRES 3060/5060—Water Quality in Natural Resource Management (3)
 FR 5130—Geographic Information Systems in Natural Resources Analysis (3)
 FR 5231—Range Management (3)
 Soil 3416—Plant Nutrients in the Environment (4)
 Soil 3417—Plant Nutrients in the Environment Laboratory (1)
 Soil 5210—Environmental Biophysics (3)
 Soil 5232—Soil Physics: Transport Processes in the Soil (4)
 Soil 5510—Field Study of Soils: Morphology (1)
 Soil 5511—Field Study of Soils: Mapping (1)
 Soil 5515—Soil Development, Classification, and Geography (1)
 Soil 5555—Wetland Soils (4)
 Soil 5560—Interpretation of Land Resources (3)
 Soil 5610—Soil Biology (4)
 Soil 5710—Forest Soils (3)

Any 3xxx course in biochemistry or organic chemistry or any adviser-approved courses that will develop interests and professional competence in soils.

Waste Management—Focus on the requirements needed to manage the waste stream. Understanding processes involved in managing wastes; implementing procedures for municipal solid waste composting, incineration, and recycling; and implications of landfilling solid waste. For more information, contact Dr. Edward I. Sucoff, 103 Green Hall, (612) 624-7249, esucoff@forestry.umn.edu.

CE 5510—Solid and Hazardous Waste Management (4)
 Econ 5611—Resource and Environmental Economics (4)
 FW 5460—Pollution Effects on Aquatic Systems (3)
 Pol 5523—Politics of the Regulatory Process (4)
 Soil 5600—Principles of Waste Management (4)
 Soil 5610—Soil Biology (4)

The following courses are highly recommended and offered in the new solid waste management

certificate program available through UC/CEE only. Not all courses are available every year. For more information consult the solid waste management certificate program adviser (612/625-2500) and the UC/CEE bulletin.

New Core Courses

Regulatory and Legal Framework of Solid Waste Management (2)
 Applied Economics of Solid Waste (2)
 Solid Waste Policy and Administration (2)

Existing Courses

CE 5098—Risk and Uncertainty in Environmental Decision Making (4)
 CE 5580—Environmental Law for Engineers (4)
 ID 5525—Garbage, Government, and the Globe (4)
 ID 5526—Garbage, Government, and the Globe (4)
 PA 5221—Law and Urban Affairs (3)
 PA 5230—Strategic Planning and Management (3)
 Pol 5610—Environmental Ethics, Politics, and Public Policy (4)
 PubH 5150—Topics: Environmental Health Law I (3)
 PubH 5150—Topics: Environmental Health Law II (3)
 PubH 5255—Hazardous Materials Management (3)
 PubH 5253—Introduction to Hazardous Waste Management (3)

Water Resources—Focus on the management of water resources to achieve desired water quantity and quality. Special emphasis on water movement, storage, and hydrologic and climatologic cycles. (Students should take Math 1251 and 1252 in place of Math 1142.) For more information, contact Dr. Kenneth N. Brooks, 301 Green Hall, (612) 624-2774, kbrooks@forestry.umn.edu; or Dr. James A. Perry, 312 Green Hall, (612) 624-9796, jperry@forestry.umn.edu.

BAE 5540—Watershed Engineering (4)
 BAE 5550—Water Management Engineering (4)
 AgET 5410—Hydrology and Water Quality (5)
 CE 3400—Fluid Mechanics (4)
 CE 5401—Water Resources Engineering (4)
 CE 5505—Water Quality Engineering (4)
 CE 5510—Solid and Hazardous Waste Management (4)
 CE 5515—Water and Wastewater Microbiology (4)
 FR 3104—Forest Ecology (4)
 or EEB 3001—Introduction to Ecology (4)
 FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
 FR 5114—Forest Hydrology and Watershed Management (4)
 FR 5115—Forest Hydrology: Field Applications (2)
 FR 5153—Advanced Forest Hydrology (4)
 FW 5460—Pollution Impacts on Aquatic Systems (2)
 Geo 5601—Limnology (4)
 Geo 5641—General and Physical Hydrology (4)
 Geog 5444—Geography of Water Resources, Individuals, and Institutions (4)
 Hort 5015—Restoration and Reclamation Ecology (4)
 NRES 3060/5060—Water Quality in Natural Resource Management (3)
 Soil 5240—Microclimatology (4)

This is the Course Descriptions section of the 1996-1999
University of Minnesota College of Natural Resources Bulletin.

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:

- , The comma, used in prerequisite listings, means “and.”
- † All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.
- § Credit will not be granted if credit has been received for the course listed after this symbol.
- ¶ Concurrent registration is required (or allowed) in the course listed after this symbol.
- # Approval of the instructor is required for registration.
- Δ Approval of the department offering the course is required for registration.
- Approval of the college offering the course is required for registration.
- H Honors course (follows the course number).

A prerequisite course listed by number only (e.g., prereq 5246) is in the same department as the course being described.

Agricultural and Applied Economics (ApEc)

ApEc 1101. Principles of Microeconomics. (4 cr, §Econ 1002; prereq 1102)
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.

ApEc 1102. Principles of Macroeconomics. (4 cr, §Econ 1001)
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.

ApEc 3040. Economic Development of American Agriculture. (4 cr; prereq 1101 or Econ 1101)

Review of economic, political, social, and technical forces that have shaped the development of American agriculture; role of agricultural development in national economic development in the United States; implications for presently developing countries.

ApEc 3610. Resource Development and Environmental Economics. (4 cr; prereq 1101, 1102 or Econ 1101, Econ 1102 or #)

Resource use concepts, including physical and economic classifications, physical and economic feasibility, benefits and costs, external effects, cost sharing, selected resource use problems. Economic areas and units for planning and development; generation of alternative program elements and development of consequences; problems in choosing elements for an optimum resource development program.

ApEc 5600. Land and Water Economics. (3 cr; prereq 1101 or Econ 1101)

Land and water as public resources and as factors of production; economic analysis of policies that influence asset use; sale and rental markets; valuation of rights to land and water, taxation and regulation as instruments influencing private management decisions; comparative land and water legal and market settings.

ApEc 5650. Economics of Natural Resource and Environmental Policy. (4 cr; prereq 3002 or 3610 or Econ 3101 or #)

Application of economic analysis, including project evaluation, to current natural resource and environmental issues. Emphasis on conservation and resource scarcity, environmental quality, and resource use issues and their implications for public policy.

Chemistry (Chem)

Chem 1001. General Principles of Chemistry. (4 cr, §1008, §1031-1032, §1051-1052)

Introduction to chemistry, matter and energy, atoms, molecules, chemical bonding, the mole and chemical calculations, gases, liquids, solids, solutions, chemical reactions, acids, bases and equilibrium.

Chem 1002. Elementary Organic Chemistry.

(4 cr, §3301, §3302; prereq 1001 or advanced placement by exam)
Short introduction to organic chemistry with emphasis on biological systems.

Chem 1051-1052†. General Principles I-II. (4 cr per qtr, §1001-1002, §1031-1032)

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

Chem 3100. Quantitative Analysis Lecture.

(3 cr; prereq 1052 for non-chem majors)
Theory of quantitative chemical analysis.

COURSE DESCRIPTIONS

Chem 3101. Quantitative Analysis Laboratory. (2 cr; prereq 3100 for non-chem majors; 8 lab hrs per wk)

Lab introduction to quantitative chemical analysis.

Chem 3301. Elementary Organic Chemistry I. (4 cr, §3331; for non-chem majors; prereq 1005 or 1032 or equiv; 4 lect hrs per wk)

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

Chem 3302. Elementary Organic Chemistry II.

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

Continuation of Chem 3301.

Chem 3305. Elementary Organic Chemistry Laboratory I. (2 cr; prereq 3301 or ¶3301; 1 lab conf, 4 lab hrs per wk)

Techniques used to prepare typical organic substances.

Chem 3306. Elementary Organic Chemistry Laboratory II. (2 cr; prereq 3302 or ¶3302; 1 lab conf, 4 lab hrs per wk)

Techniques used to prepare typical organic substances.

Fisheries and Wildlife (FW)

FW 1001. Orientation in Fisheries and Wildlife. (1 cr)

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

FW 1002. Wildlife: Ecology, Values, and Human Impact. (3 cr)

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

FW 3052. Introduction to Fisheries and Wildlife Conservation. (3 cr)

Ecological principles applied to managing fish and wildlife populations and their habitats; legislation, agencies, and policy affecting fish and wildlife conservation.

FW 3054. Biological Conservation: An Ecosystem Approach. (3 cr; prereq one ecol course)

History and current issues in biological conservation; conservation theory and practice, including management for sustained yield, exotic and endangered species, and design of protected areas. Global ecosystems; case studies of management at the landscape level.

FW 3106. Important Plants: Fisheries and Wildlife Habitats. (2 cr; prereq ¶3600 or #, □; at Itasca)

Field identification of important plants in fisheries and wildlife habitats.

FW 5129. Mammalogy. (5 cr, §EEB 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.

FW 5200. Honors Research. (3 cr; admission to FW honors program)

Lectures and discussions on current topics presented by faculty and students.

FW 5278. Special Lectures: Wildlife. (Cr ar; offered when feasible)

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

FW 5279. Special Lectures: Fisheries. (Cr ar; offered when feasible)

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

FW 5393. Special Problems: Fisheries Biology. (Cr ar; prereq #)

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

FW 5398. Special Problems: Wildlife Biology. (Cr ar; prereq #)

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

FW 5455. Aquaculture. (3 cr; prereq Biol 1009, 1103, 1106 or equiv, Chem 1051-52 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.

FW 5459. Fish Physiology. (4 cr; prereq AnSci 3301 or EEB 5136 or EEB 5156 or #)

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

FW 5460. Pollution Impacts on Aquatic Systems. (2 cr; prereq Biol 5041, EEB 5601, Chem 1051-1052, 3301, 3305 or #; offered alt yrs)

Pollution assessment approaches, biological effects, fate and flow of contaminants in aquatic systems and major types of pollutants will be described.

FW 5461. The Behavior of Fishes. (3 cr; prereq EEB 1111 or FW 5459 or #, offered alt yrs)

Organismal and sub-organismal perspectives of fish behavior. Feeding behavior and optimal foraging theory, learning and intelligence in fish, genetic basis of behavior, neural and endocrine bases of behavior, communication, orientation and navigation, schooling and shoaling, reproduction, and application of an understanding of fish behavior to the harvest, management, and conservation of fishes.

FW 5465. Sustainable Fisheries and Aquaculture. (5 cr; prereq general biology, chemistry, ecology; at Itasca)
Study of the structure and function of indigenous fisheries and aquaculture ecosystems as models for sustainable aquatic ecosystems management and development. Course, field, and lab work examines fisheries ecology of Lake Itasca and its environs as examples of intact, headwaters ecosystems; experiments using lake microcosms are conducted and field work examines an intensive, lake-based cage aquaculture operation in northern Minnesota.

FW 5565. Fisheries and Wildlife Ecology and Management: Field Trip. (1 cr)
Ten-day field trip to Wyoming and points en route during spring break emphasizing a broad range of fisheries and wildlife management, including big game, waterfowl, and endangered species.

FW 5570. Avian Conservation. (4 cr; prereq EEB 5134 or grad standing or #; offered alt yrs)
Current problems in avian conservation and management, with equal emphasis on nongame, wetland, and game birds.

FW 5600. Fisheries and Wildlife Field Techniques. (4 cr; prereq Biol 5041 or EEB 3001 or #, □; at Itasca)
Introduction to various field techniques and skills; planning and implementing field projects; data collection and analysis using microcomputers; written reports and a field journal.

FW 5601. Fisheries Population Analysis. (4 cr; prereq NRES 1020 or computer competency, Stat 3011, Stat 3012 or Stat 5021, one qtr intro calculus)
Introduction to theory and methods for estimating vital statistics of fish populations. Students use microcomputers and statistical software to describe and model attributes of fish populations in case studies drawn from the literature of marine and freshwater fisheries management.

FW 5603. Wildlife Habitats and Management. (3 cr; prereq 3052 or 3054 or grad in biol or nat res or #, NRES 1020 or computer competency)
Environmental interactions of wildlife at both population and community levels; environmental threats from human activities; habitat management practices; objectives, policies, and regulations in population management.

FW 5604. Fisheries Ecology and Management. (3 cr; prereq NRES 1020 or computer competency, EEB 5601 or equiv or #)
Emphasis on managed species and systems. Applied aquatic and fish ecology related to fisheries. Role of planning in fisheries management. Application of management tools and assessment of their efficacy.

FW 5620. Geographic Information Systems For Fisheries, Wildlife, and Biological Conservation. (4 cr; prereq Biol 5041)
Hands-on experience with GIS as a tool for understanding, analyzing, and managing ecological systems. ARC-INFO and how to apply it to problems in fisheries, wildlife, and biological conservation.

FW 5701, 5702†. Senior Project. (1-2 cr; prereq FW sr or grad or #)
Two-quarter course providing problem-solving training. Management problem identification and analysis design, information and data gathering and analysis, and oral and written problem reporting. Problem selection influenced by guest speakers, resource agency contacts, and group discussions; topic selected is a contemporary fisheries and wildlife management issue.

FW 5801H. Honors Research. (3 cr; prereq admission to FW honors program)
First quarter of an independent research project supervised by a faculty member.

FW 5802H. Honors Research. (3 cr; prereq FW 5801H)
Continuation of FW 5801H. Students complete honors thesis and present an oral report.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

FW 8200. Seminar

FW 8364. Research in Fisheries Biology

FW 8377. Research in Wildlife Biology

FW 8448. Fishery Science

FW 8451. Production Biology of Fishery Environments

FW 8452. Conservation Biology: Genetic and Demographic Issues

FW 8459. Stream and River Ecology

FW 8460. Fish Habitats and Restoration

FW 8576. Wildlife Management: Large Mammals

FW 8579. Ecosystem Analysis and Simulation: A Numerical Approach

Forest Products (ForP)

ForP 1001. Forest Products Orientation. (1 cr)
Information about curricula offerings, specializations, career options, liberal education requirements, financial aid, scholarships, summer employment, and other student-related concerns.

ForP 1301. Wood as a Raw Material. (4 cr)
Physical and chemical nature of solid wood and wood fiber as it relates to the requirements of major wood-based industries. World supply and consumption. Weekly demonstration labs dealing with structure and properties of wood and manufacture of solid, particle, and fiber products.

ForP 1303. Wood Structure and Identification. (2 cr; prereq 1301 or #)
Features of wood structure vital to identifying wood of various tree species and understanding physical properties of wood. Lecture and lab.

COURSE DESCRIPTIONS

ForP 3300. Wood Industry Tours. (2 cr; prereq 1301; jr or sr standing or #)

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

ForP 3301. Industrial Internship. (2 cr; prereq ForP cooperative ed student)

Industrial work assignment in FP cooperative education program. Evaluation based on formal report written by student at end of each quarter of work assignment.

ForP 3303. Forest Products Marketing. (3 cr)

Survey of marketing in the forest products industry, including review of basic marketing concepts and terminology.

ForP 3305. Grading Standards and Product Performance. (2 cr; prereq 1301, 1303 or #)

History, development, and practical application of hardwood and softwood log and lumber grading methods.

ForP 3312. Building Materials Estimating. (2 cr)

Modern methods of estimating quantity, grade, and specifications of building materials for light-frame construction.

ForP 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.

ForP 3361. Introduction to Adhesives. (3 cr; prereq BioC 1301, Phys 1042; offered even yrs)

Scope and use of adhesive applications. Fundamental nature of adhesion; ideal adhesive joint. Adhesive polymers. Fabrication and mechanical properties of adhesively bonded assemblies.

ForP 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.

ForP 5301. Mechanical Properties. (3 cr; prereq 1301 or #)

Basic mechanics and strength of materials as applied to wood products.

ForP 5302. Wood Chemistry I. (3 cr; prereq Chem 3302)

Molecular structure of wood cell wall. Structure, properties, and reactions of monosaccharides and derivatives; oligosaccharides. Structure, properties, and biogenesis of cellulose; cellulose derivatives; comparison with starch.

ForP 5303. Wood Deterioration. (4 cr; prereq 1301 or #)

Deterioration of wood and wood products by bacteria, fungi, insects, marine organisms, fire, and weathering; methods of preservation and preservatives used. Lecture and lab.

ForP 5304. Wood Drying and Preservation Processes. (4 cr; prereq 5300, 5303)

Materials, equipment, processes, and technical considerations inherent in the industrial drying and/or preservative treatment of wood products. Lectures, lab exercises, plant visits.

ForP 5305. Pulp and Paper Technology. (2 cr; prereq 5300 or #)

Pulping processes, fiber refining and processing, paper manufacturing, fiber and paper properties; paper recycling; water requirements and effluent treatment.

ForP 5306. Analysis of Production Systems. (3 cr; prereq 1301 or #; 3300 recommended)

Engineering and economic analysis of manufacturing and distribution systems for wood-based products. Material balances, equipment selection, economic analysis, and presentation techniques.

ForP 5307. Wood-Base Panel Technology. (4 cr; prereq 5300, 5301 or #)

Design, manufacture, properties, and applications of structural and nonstructural wood-base panels. Adhesives and their application in the panel industry. Lecture and lab.

ForP 5308. Wood Machining. (3 cr; prereq 1301, 1303)

History and fundamentals of wood machining processes. Analysis of tool and workpiece interaction and the effects on recovery efficiencies, tool wear, and surface condition. Application of wood processing systems and technologies.

ForP 5310. Pulp and Paper Process Laboratory. (3 cr; prereq 5305 or #)

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

ForP 5311. Pulp and Paper Process Calculations I. (4 cr; prereq AgET 3030, CE 3400, ChEn 5001, ME 3301)

Physical and chemical process engineering calculations; steady and unsteady state material and energy balances applied to pulping and papermaking processes; flowsheet and system calculations; computer-aided material and energy balances.

ForP 5312. Pulp and Paper Process Calculations II. (4 cr; prereq 5311 or ChEn 5101, ¶ME 3301)

ForP 5313. Pulp and Paper Process Operations I. (4 cr; prereq 5305, 5312, 5353, CE 3400, ME 3301, ME 5342 or ChEn 5102 or #)

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

ForP 5314. Pulp and Paper Process

Operations II: Paper Machine Operations, Finishing and Converting. (3 cr; prereq 5305, 5310, 5311, 5312, 5315, 5359, ¶5321, CE 3400, ME 3301, ME 5342 or #)

Theory and practice of the design and operation of paper machines and associated finishing and converting equipment.

ForP 5315. Paper Engineering Laboratory.

(2 cr; prereq 5305, 5310 or ¶5310, 5312 or #)

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

ForP 5316. Coated Product Development. (2 cr; prereq 5359)

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

ForP 5318. Pulp and Paper Process Dynamics and Control. (3 cr; prereq 5305, 5310, 5311, 5312, 5315, ¶5321, CE 3400, ME 3301, ME 5342 or #)

Theory and practice of process control in the pulp and paper industry: sensors, control equipment and algorithms, final control elements; applications to industrial pulp and paper manufacturing, available hardware and software.

ForP 5320. Biological and Environmental Science of Pulp and Paper. (3 cr; prereq ForP jr or sr, or grad standing or #)

Biological systems and process technology as they affect pulp and paper raw materials, manufacturing, waste treatment, and recycling. Regulations and compliance for mill expansion regarding environmental impacts, effluents, and discharge. Current developments in biological applications (e.g., enzyme treatments, biopulping, slime control) in the industry.

ForP 5321. Material Science of Paper (Paper and Fiber Physics and Properties). (4 cr; prereq 5305, 5310, 5311, 5312, 5315, 5359, CE 3400, ME 3301, ME 5342, ¶Chem 5520 or #)

Advances in understanding the response of fibers subjected to various operations of papermaking processes: mechanisms acting in stock preparation, refining, wet-end operations, web consolidation and drying; analysis of their corresponding influences on fiber, pulp suspension, and paper properties; challenges placed on end products by changing raw materials and requirements, including introduction of recycled pulp in paper products.

ForP 5331. Undergraduate Seminar. (2 cr;

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

ForP 5350. Woody Tissue Microtechnique. (2 cr; offered when feasible)

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

ForP 5353. Wood Chemistry II. (3 cr; prereq 5302)

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

ForP 5355. Mechanics and Structural Design With Wood Products. (4 cr; prereq 5301)

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

ForP 5356. Advanced Forest Products Marketing. (3 cr; prereq 3303 or #)

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

ForP 5359. Surface and Colloid Chemistry of Papermaking. (3 cr; prereq 5361 or #, Chem 3302, ME 3301, ¶Chem 5520)

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

ForP 5361. Adhesion and Adhesives. (3 cr; prereq Chem 3302)

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

ForP 5401. Senior Topics. (Cr ar; prereq sr, #)

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

ForP 5405. Paper in Today's World. (3 cr, §5305; UC/CEE only)

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

ForP 5410. Understanding Wood. (2 cr; UC/CEE only)

For woodworking professionals and serious craftspeople. Cellular structure of wood, identification of hardwoods and softwoods, interaction of water and wood. No prior technical training in wood properties is needed. Although general experience with woodworking is helpful.

ForP 5412. Understanding Residential Construction: The House as a System. (3 cr; UC/CEE only)

For builders, architects, and building materials suppliers. Energy, moisture control, and indoor air quality in residential buildings. Emphasis on design, construction, and operational aspects of the house to provide energy efficiency, durability, and a healthy environment. Interaction between moisture and wood products within the building system.

COURSE DESCRIPTIONS

ForP 5420. Using Process Simulation in the Pulp and Paper Industry. (2 cr; UC/CEE only)

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

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

ForP 8300. Research Problems

ForP 8301. Research Problems

ForP 8304. Advanced Topics in Wood Drying

ForP 8306. Seminar: Forest Products

ForP 8307. Advances and Methods in Forest Products Pathology and Preservation

ForP 8310. Mechanics of Wood and Wood Composites

Forest Resources (FR)

FR 1001. Forest Resources Orientation. (1 cr)

Information about curricula offerings; liberal education requirements; careers in forest resources, urban forestry, and recreation resource management; and summer job and internship programs.

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 lab methods of identification.

FR 3100. Minnesota Plants. (2 cr; prereq Biol 1103, Δ ; at Itasca)

Identification of plants as related to habitat.

FR 3101. Northern Forest Ecosystems. (3 cr; prereq Chem 1001 or Chem 1051, Δ ; at Itasca)

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

FR 3102. Southern Forest Resource Tour.

(1 cr; prereq FR jr or sr or #; offered odd yrs)
One-week field tour of selected southern forest industries and public forest management agencies. Walnut production, southern pine silviculture, hardwood use, various mill tours. Discussions, paper.

FR 3103. Meteorology and Climatology for Natural Resource Managers. (2 cr; prereq Biol 1009, Geo 1001, Math 1142, Phys 1001, Phys 1005)

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

FR 3104. Forest Ecology. (4 cr; prereq 8 cr biol, 4 cr chem)

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

FR 3107. Forest Ecology Laboratory. (1 cr, §3101; prereq ¶3104)

Forest stands, communities, and ecosystems. Field trips.

FR 3201. Forest Measurement Techniques. (1 cr; prereq Math 1008, Δ ; at Itasca)

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

FR 3225. Directed Study Experience. (1-5 cr; prereq fr or soph standing, #)

Opportunity to pursue experiences not available under independent study or extra credit registration. 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.

FR 3250. Role of Renewable Natural Resources in Developing Countries. (2 cr)

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

FR 3300. Elements of Surveying. (2 cr; prereq Math 1008 or high school trig, Δ ; at Cloquet)

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

FR 3500. Arboriculture. (3 cr; prereq Biol 1103, Hort 1021 or FR 1100)

Selecting, planting, and caring for landscape, street, and park trees. Emphasis on proper plant site decisions, plant health care practices, and minimizing stresses from the urban environment, insects, and diseases.

FR 5100. Silviculture. (4 cr; prereq 1100, 3104 or equiv, #)

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

FR 5101. Field Silviculture. (4 cr; prereq 5100, Δ ; 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.

FR 5102. Forest Wildlife Habitat Management.

(1 cr; prereq FW 3052, ¶FW 5100, Δ ; at Cloquet)

Forest vegetation management techniques for developing and maintaining wildlife habitat; consideration of vegetation dynamics, habitat requirements, and silvicultural techniques.

FR 5104. Forest Ecology. (4 cr; prereq 8 cr biol, 4 cr chem)

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

FR 5106. Senior Silviculture Seminar. (2 cr, 3 cr with research paper; prereq sr, 5100 or #)

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

FR 5107. Forest Ecology Laboratory. (1 cr, \$5160; prereq ¶5104)
Forest stands, communities, and ecosystems. Field trips.

FR 5108. Physiological Ecology: Organisms to Ecosystems. (3 cr; prereq 5103 or 5104 or Biol 5041 or Hort 5041)

Interaction between plants and their environment; mechanisms that affect whole plant, community, and ecosystem processes. Causes and consequences of variation in resource availability and stress in diverse ecosystems. Relationships of resource availability and stress to plant establishment, growth, and survival; links between organismal, community, successional, and ecosystem processes.

FR 5114. Forest Hydrology and Watershed Management. (4 cr; prereq 3103, Biol 1009, Chem 1052, Geo 1001, Math 1142, Phys 1001 or #)

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

FR 5115. Forest Hydrology, Field Applications. (2 cr; prereq 5114, Δ; 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.

FR 5120. Tree Biology. (4 cr; prereq Chem 1001 or Chem 1051, 10 cr biol)

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

FR 5126. Silviculture: Soil-Site Relationships. (2 cr; prereq 5100, Δ; at Cloquet)

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

FR 5130. Geographic Information Systems in Natural Resource Analysis. (3 cr; prereq sr or grad or #)

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

FR 5142. Tropical Forest Ecology. (3-4 cr; prereq 1 Ecol course 3xxx level or higher)

Ecological principles related to form, function, and development of wet and dry tropical forests at organismal, community, and ecosystem scales. Succession, productivity, biodiversity, sustainability, agroforestry, and management alternatives. Natural distribution of forest types; causes, consequences, and extent of deforestation.

FR 5146. Dynamics of Global Change: Plant Ecology. (3-4 cr; prereq 1 plant ecol or plant phys course 3xxx level or higher)

Implications of global change elements for wild and cultivated vegetation, including forests, grasslands, and agricultural ecosystems. Responses on ecosystem, community, organismal, and physiological scales. Potential climate change, elevated atmospheric concentrations of carbon dioxide, ozone, and other trace gases, acid deposition, and other pollutants.

FR 5152. Forest Genetics. (3 cr; prereq Biol 1103, Stat 3011)

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

FR 5153. Advanced Forest Hydrology. (4 cr; prereq 5114 or #)

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

FR 5160. Practicum in Forest Biology and Measurements. (3 cr; prereq grad, #; at Itasca)

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

FR 5202. Remote Sensing: Field Applications. (2 cr; at Cloquet)

Field applications of remote sensing for inventory, mapping and monitoring forest and natural resources.

FR 5215. Forest Fire Ecology and Management. (2 cr; prereq Itasca session, 1100, 3103, 5100 or #)

Effects and control of fire on wild landscapes, especially forests and grasslands. Fire effects on vegetation, fire history studies, fire behavior, fuel load modeling, fire policy in land management.

FR 5218. Assessment and Modeling of Forests. (3 cr; prereq Math 1142 or Math 1251-1252, NRES 5210, Stat 3011 or Stat 5121)

Measurement and sampling methods for forest vegetation; tree and stand growth modeling; landscape processes, characteristics, and modeling.

FR 5222. Forest Resources Inventory. (2 cr; at Cloquet)

Field application of sampling methods for estimating natural resource characteristics for inventory, appraisal, and monitoring.

FR 5225. Directed Study Experience. (1-5 cr; prereq jr or sr or grad standing, #)

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.

FR 5228. Advanced Topics in Resource Assessment and Modeling. (4 cr; prereq 5218 or equiv, NRES 5210 or equiv, Stat 5021 or equiv)
Recently developed mathematics, computer science, and statistics methodologies applied to resource functioning, management, and use problems.

COURSE DESCRIPTIONS

FR 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.

FR 5232. Management of Recreational Lands.

(4 cr; prereq completion of all lower div reqs; jr or sr status)

Understanding and applying recreation management tools from a public agency perspective. Management concepts such as ROS, LAC, social monitoring, and public information processes.

FR 5236. Forest Recreation Planning. (1 cr; prereq 5232, Δ; at Cloquet)

Recreation area and site planning, examples and managerial concerns. Fieldwork and presentation.

FR 5248. Harvesting and Engineering. (3 cr; prereq 3300 or CE 3100, Δ; at Cloquet)

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

FR 5250. Role of Renewable Natural Resources in Developing Countries. (2 cr)

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

FR 5257. Recreation Land Policy. (3 cr; prereq 5232 or #)

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

FR 5259. Analysis of Outdoor Recreation Behavior. (3 cr; prereq 5232, RRM major or grad or #)

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

FR 5262. Remote Sensing of Natural Resources. (4 cr)

Overview of remote sensing basics, interpretation, measurement, and mapping from aerial photography; introduction to digital remote sensing and image analysis.

FR 5264. Quantitative Techniques in Forest Management. (3 cr; prereq 5218, 5270 or #)

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

FR 5270. Forest Management and Planning. (3 cr; prereq 5218, ApEc 1101 or Econ 1101, ApEc 1102 or Econ 1102, NRES 5260)

Role of models in resource decisions at the stand and forest-wide levels; forest regulation principles and techniques; forest management scheduling approaches; economic tradeoff and impact analysis principles.

FR 5403. Fundamentals of Natural Resource Education. (1-3 cr; UC/CEE only)

For elementary teachers. Study of soil, water, forest, and wildlife resources of Minnesota and the biological principles and ecological implications of management. Environmental issues created by natural resource manipulation. Development of outdoor teaching skills in environmental education in a metropolitan center.

FR 5412. Advanced Remote Sensing. (4 cr; prereq 5262 or #)

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

FR 5460. Water Quality: The International Dimension. (3 cr; prereq 5114 or NRES 3060, one Ecol course, jr or sr status)

Water quality management practices and policies in foreign countries. Water quality as one of many natural resources being managed by rapidly changing societies. World literature in natural resources.

FR 5500. Urban Forest Management. (4 cr)

Terminology, urban tree inventory, forest care and health evaluations principles; case studies; sociology of urban forestry and best management practices.

FR 5704. Colloquium in Natural Resources. (1-4 cr; prereq varies with topic, #)

Colloquium on specialized topics in natural resources.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

FR 8100. Research Problems: Silviculture

FR 8101. Research Problems: Forest-Tree Physiology

FR 8102. Research Problems: Forest-Tree Genetics

FR 8103. Research Problems: Forest Hydrology

FR 8104. Research Problems: Forest Ecology

FR 8107. Seminar: Forest Resources

FR 8112. Research Problems: Physiological Ecology

FR 8200. Research Problems: Forest Management

FR 8201. Research Problems: Forest Economics

FR 8202. Research Problems: Forest Biometry

FR 8203. Research Problems: Forest Recreation

FR 8204. Research Problems: Forest Policy

FR 8205. Research Problems: Remote Sensing

FR 8207. Economic Analysis of Forestry Projects

FR 8211. Seminar: Natural Resource Policy Issues

FR 8301. Teaching Practicum

Mathematics (Math)

Math 1031. College Algebra and Probability. (4 cr, §1051, §1111, §1151, §1201; prereq 3 yrs high school math, placement exam or GC 0631 with a grade of C or better)

Algebra and analytic geometry explored in greater depth than is usually done in three years of high school mathematics. Additional topics from combinations, permutations, and probability. A suitable prerequisite for Math 1131 or 1142, but not for 1251.

Math 1131. Finite Mathematics. (5 cr; prereq 3 yrs high school math incl probability, satisfactory placement exam or grade of C or better in 1031) Elementary computer programming, financial mathematics, probability, linear algebra, linear programming, Markov chains.

Math 1142. Short Calculus. (5 cr; for students requiring minimal amount of calculus; prereq 3 yrs high school math, satisfactory placement exam or grade of C or better in 1031 or 1151) Derivatives, integrals, differential equations, maxima and minima, partial differentiation, applications.

Math 1151. Precalculus II. (4 cr, §1008, §1111, §1201; prereq 3½ yrs high school math, placement exam or 1051 with a grade of C or better) Second of two courses (see Math 1051) in algebra, analytic geometry, and trigonometry. Prepares students for the full calculus sequence. Not an acceptable prerequisite for Math 1131.

Math 1251-1252. One-Variable Differential and Integral Calculus I-II. (4 cr per course, §1411H-1421H, §1451H-1452H; prereq 4 yrs high school math incl trig, satisfactory placement exam or grade of C or better in 1151; grade of C or better in 1251 required for 1252) Calculus of functions of one variable and related geometry and applications.

Math 1261. The Algebra and Geometry of Euclidean Space. (4 cr, §1241, §1553H, §3142, §3511H; prereq 1251) Vectors and their operations; matrices and matrix algebra, linear algebraic equations; Gaussian elimination; determinants and their applications; linear transformations; subspaces, quadratic functions, rigid motions, and orthogonal matrices.

Math 3251. Multivariable Differential Calculus. (4 cr, §3211, §3311, §3521H, §3552H; prereq 1251, 1261) Differentiation of parametric curves; partial differentiation and the derivative as local linear approximation; the chain rule; applications to maximum/minimum problems with attention to boundaries and constraints, including Lagrange multipliers; Taylor's Theorem (multivariable) and the second derivative test.

Math 3252. Multivariable Integral Calculus. (4 cr, §for students with [3211, 3331] or [3311, 3331] or 3551H or 3552H; prereq 1252, 3251 or ¶3251) Double and triple integrals; change of variable procedures with emphasis on polar and spherical coordinates; mass and centroid; integration on curves and surfaces; vector fields and the theorems of Green, Gauss, and Stokes.

Math 3261. Differential Equations With Linear Algebra. (4 cr, §3221, §3321, §3531H, §3551H; prereq 1221 or 1251, 1241 or 1261 or 3142) First-order equations, linear equations with constant coefficients, and linear systems. Companion topics from linear algebra; general vector spaces, independence, spanning sets, basis, dimension, eigenvalues, and eigenvectors.

Math 3262. Infinite Sequences and Series With Methods of Approximation. (4 cr; prereq ¶3261) Infinite sequences and series; mathematical induction and its implications for recursively defined sequences; convergence and techniques for evaluation of sequential limits and sums of series; applications of sequences and series to approximations and estimates of error. Required for honors students who have not taken Math 1552H.

Natural Resources and Environmental Studies (NRES)

NRES 1001. Orientation to Natural Resources and Environmental Studies. (1 cr; S-N only) Information about NRES major. Discussions with faculty adviser. Employment information. Current topics in NRES. Information about facilities. Discussions with alumni.

NRES 1020. Information Technology in Natural Resources. (2 cr) Overview of computers and computer-based tools as they apply to NRES and related coursework. Techniques for information retrieval.

NRES 1040. Natural Resources as Raw Materials. (3 cr) Role of natural resources as raw materials for industry and economic development. Environmental and economic trade-offs associated with raw material gathering, processing and use. Implications of processing technologies, energy considerations.

NRES 1201. Conservation of Natural Resources. (3 cr) Natural resource conservation and its development in the United States; renewable resources and problems managing them, relates resource conservation and environmental management to their basic ecological principles.

NRES 3001. Colloquium in Natural Resources and Environmental Studies. (1 cr) Roundtable discussions of current NRES topics.

NRES 3010. Ethics and Values in Resource Management. (3 cr) Formulating a natural resources philosophy based on ethical behavior. Ethical dilemmas inherent in managing natural resources.

COURSE DESCRIPTIONS

NRES 3020. Plant Resource Management and the Environment. (4 cr; prereq ¶5020, Biol 1009 or Biol 1201, Biol 1202, soph standing)

Same as NRES 5020. World vegetation management practices, extent. Emphasis on forest management; agriculture and agroforestry; historical, current, and prospective practices and environmental and societal implications.

NRES 3050. Experience and Training in a Field Setting. (1-4 cr; prereq #)

Students are required to obtain professional experience in a field setting by attending field sessions, completing a Professional Experience Program, or volunteering for various natural resource and/or environmental programs through local state or federal agencies. Approval by instructor required.

NRES 3060. Water Quality in Natural Resource Management. (3 cr; prereq Biol 1009, Geo 1001, Math 1142, Phys 1001, Phys 1005, one ecol course)

Same as NRES 5060. Global and ecological perspective on managing surface and groundwater resources. Water quality concerns.

NRES 3070. From Local to Global Ecology. (3 cr)

Ecosystem processes worldwide, plants and animals they support, human impacts; cultural and economic determinants of environmental problems related to ecosystems and solutions to these problems.

NRES 3100. Conservation of Biodiversity. (4 cr)

Biological and social principles underlying biodiversity conservation. Management and policy alternatives for maintaining biodiversity.

NRES 3201. Field Assessment Techniques.

(1 cr; at Itasca)

Land survey and mapping; measurement and sampling methods for forest vegetation, wildlife, and other resources.

NRES 3202. Leadership and Management Skills Development. (3 cr; prereq jr or sr standing)

Presentations and classroom exercises on managing, planning, directing, controlling, and organizing; group problem solving, implications of organizational change, time management, and career planning and development.

NRES 3225. Directed Study Experience. (1-5 cr; prereq fr or soph standing; #)

Opportunity to pursue experiences not available under independent 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.

NRES 3575. Wetlands Conservation. (3 cr; prereq Biol 5041 or EEB 3001 or EEB 3101)

Freshwater wetland classification, biota, current/historic status, value, conservation strategies, ecological principles used in wetland management.

NRES 5001. Colloquium in Natural Resources and Environmental Studies. (1 cr)

Key concepts and techniques in restoration; common factors in restoration projects; threats to health of aquatic ecosystems.

NRES 5020. Plant Resource Management and the Environment. (4 cr; prereq ¶3020)

Same as NRES 3020. Discussion period; term paper.

NRES 5060. Water Quality in Natural Resource Management. (3 cr; prereq Biol 1009, Math 1142, Phys 1001, Phys 1005, Geo 1001, one ecol course; ¶NRES 3060)

Same as NRES 3060. Weekly discussion period; integrative paper on a water quality problem.

NRES 5100. Problem Solving in Natural Resources and Environmental Studies. (5 cr; prereq 5210 or Stat 3012, Rhet 3562; completion of at least 12 cr in area of concentration for NRES majors; completion of 5245, FR 5232 for RRM majors)

Solving a real-world natural resources and/or environmental problem. Discussions and assignments reflect diverse aspects of the problem. Oral and written presentations. Students participate as a member of a team.

NRES 5101. Integrated Natural Resource Planning. (5 cr; prereq 5210, 5240, FR 5218, FR 5270, one ecol course, one hydro course, one rec mgmt course or #)

Opportunity to apply skills from individual course subjects in addressing natural resource management questions. Information and models useful for assessing impact of natural resource management and trade-offs between alternative management approaches.

NRES 5210. Survey, Measurement, and Modeling Methods for Natural Resources I.

(4 cr; prereq 1020 or CSci 3101 or CSci 3102 or CSci 3113 or GC 1571, Math 1142 or 1251, Stat 3011 or Stat 5021)

Introduction to survey design, measurement concepts, and modeling methods useful in studying natural resources and environmental issues. Emphasis on data collection and analysis.

NRES 5220. Survey, Measurement, and Modeling Methods for Natural Resources II.

(4 cr; prereq 5210; offered alt yrs)

Advanced survey design, measurement concepts, and modeling methods for studying natural resources and environmental problems.

NRES 5225. Directed Study Experience. (1-5 cr; prereq jr or sr or grad standing, #)

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.

NRES 5240. Natural Resources Policy and Administration. (3 cr; prereq ApEc 1101 or Econ 1101, ApEc 1102 or Econ 1102, Pol 1001, Rhet 1151)

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

NRES 5242. Management of Natural Resources Conflict. (3 cr; prereq NRES 5240 or #) Strategies and techniques used in conflict management and planning within the context of disputes involving the use and management of natural resources.

NRES 5245. Fundamentals of Landscape Planning for Recreation. (3 cr; prereq 5260 or FR 5232 or Rec 5310) Recreational planning from an ecosystem-based perspective. Identify recreation problems and opportunities in natural settings, establish goals, inventory and analyze the human resource, perform suitability analysis, select plan options.

NRES 5260. Economics and Natural Resources Management. (3 cr; prereq ApEc 1101 or Econ 1101, ApEc 1102 or Econ 1102) Economic concepts and tools needed for natural resources management. Financial and economic valuation, assessment methods, and links to planning and management. Cash flow analysis and benefit cost analysis methods and examples.

NRES 5575. Wetlands Conservation. (4 cr; prereq Biol 5041 or #, EEB 3001 or 3101) Same as NRES 3575 plus one additional hour per week. Freshwater wetland classification, biota, current/historic status, value, conservation strategies, ecological principles used in wetland management.

NRES 5703. Agroforestry: Role in Watershed Management. (2 cr; prereq jr or sr status or grad, background in biological and physical sciences) Agroforestry practices, and the production and watershed protection benefits derived from them. Examples from developing countries in Africa, Asia, and Latin America. Guest speakers.

NRES 5800. Natural Resources Interpretation and Communication. (3 cr) Environmental education in the context of natural resources agencies.

Physics (Phys)

Phys 1001. The Physical World. (4 cr, §any other physics courses except 1061) Conceptual introduction to modern discoveries and theories in physics; discussion of their applications and importance in today's society. Relativity, cosmology, atomic physics, nuclear physics, solid state physics, superconductivity, computers, lasers, quarks, and unification theory. Development of classical background as needed.

Phys 1005. Physics Laboratory. (1 cr; prereq 1001 or ¶1001; S-N only) Lab experiments offered with Phys 1001.

Phys 1041-1042. Introductory Physics. (5 cr per qtr, §any other intro physics courses) Lectures and problem sessions. Mechanics, fluids and gases, heat, waves, electricity and magnetism, light, optical instruments, atoms and spectra, nuclei, radioactivity.

Phys 1104, 1107. General Physics and Laboratory. (5 cr; prereq high school calculus or Math 1142 or equiv, high school trig or Math 1108 or Math 1151) Forces and their effects. Physics principles. Description of motion, forces, conservation principles, fields, and the structure of matter.

Phys 1105, 1108. General Physics and Laboratory. (5 cr) Conservation principles.

Phys 1106, 1109. General Physics and Laboratory. (5 cr) Selected topics with applications in biology.

Phys 1251-1252-1253-1254. General Physics. (4 cr per qtr; prereq Math 1251, Math 1221 or ¶1221 for 1252, Math 1241 or ¶1241 for 1253; 3 lect, 1 rec, 2 lab hrs per wk) Calculus-level course. *1251:* Mechanics. *1252:* Heat, electricity. *1253:* Magnetism, optics. *1254:* Twentieth-century physics.

Rhetoric (Rhet)

Rhet 1101. Writing to Inform and Persuade. (4 cr, §Comp 1011; prereq ¶1104) Relationship of fact finding and clear thinking to informative and persuasive writing. Importance of thesis sentence, evidence, coherence, clarity, and correctness. Relatively short (500-750 words) assignments complement instruction in the Library Lab.

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

Rhet 1151. Writing in Your Major. (4 cr; prereq 1101, 1104, soph status) Students investigate and write on subjects related to their majors. Assignments such as literature review, abstract, fact sheet, instructions, and feature article.

Rhet 1222. Public Speaking. (4 cr; prereq 1101, 1104) Fundamentals of speechmaking. Emphasis on organizing the speech and projecting it to the audience.

Rhet 1302. Humanities: Modern Thought and the Industrial Revolution. (4 cr) The industrial transformation of Europe; rise of laissez-faire capitalism, socialism, Marxism; modern "individualism" and traditional views of community; utilitarianism and deontological approaches to ethics.

Rhet 1303. Humanities: Science, Religion, and the Search for Human Nature. (4 cr) Darwin's theory of evolution and its effect on 19th- and 20th-century institutions. Emphasis on attempts of social philosophers to extrapolate from biological theory to political, cultural, and religious life, scientific and religious ways of knowing; rise of existentialism.

Rhet 1310. Humanities: The Land in American Experience. (4 cr)

American attitudes toward the land from colonial times to the present as expressed in social history, literature, and the fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of the United States.

Rhet 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.

Rhet 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.

Rhet 3562. Writing in Your Profession. (4 cr; prereq 1101, 1104, 1151, jr status)

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

Soil Science (Soil)

Soil 1020. The Soil Resource. (5 cr; prereq Chem 1001 or Chem 1051; UC/CEE only)

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

Soil 3125. Basic Soil Science. (5 cr, §1020; prereq Chem 1001 or Chem 1051)

Basic physical, chemical, and biological properties of soil. Soil genesis and classification and principles of soil fertility.

Soil 3220. Soil Conservation and Land-Use Management. (4 cr; prereq 1020 or 3125 or #)

Soil erosion and land degradation processes on rural and urban landscapes. Technical, historical, economic, social, and international considerations of soil conservation. Land-use management practices for soil conservation and methods of natural resource assessment.

Soil 3416. Plant Nutrients in the Environment. (4 cr; prereq 3125)

Fundamental concepts in soil fertility evaluation. Emphasis on dynamics of mineral elements in soil and evaluation and interpretation of plant and soil relationships.

Soil 5020. Environmental Impact Assessment. (4 cr; prereq jr or sr, 16 cr sci, 5510, ApEc 3610, #)

Roles of government agencies, consultants, and private citizens; steps needed to write an Environmental Impact Statement (EIS); case studies, writing additional components of an EIS, and preparing an EIS for a small local project.

Soil 5210. Environmental Biophysics. (3 cr; prereq Math 1251, Phys 1041 or #)

Physical microenvironment and energy/mass exchange processes among soils, plants, animals, and atmosphere. Energy transfer calculation using mathematical models and energy budget analysis.

Soil 5241. Microclimatology. (3 cr; prereq 1031 or 10 cr physics or #)

Meteorology and climatology in relation to the soil-atmosphere interface with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate description of meteorological instruments, and use of weather data.

Soil 5510. Field Study of Soils: Morphology. (1 cr; prereq 1020 or 3125 or #)

Writing and classifying soil profile descriptions in the field.

Soil 5511. Field Study of Soils: Mapping. (1 cr; prereq 5510 or ¶5510)

Making soil maps based on soil profile descriptions.

Soil 5555. Wetland Soils. (4 cr; prereq 1020 or 3125 or #)

Formation, properties, and management of peatlands important to crop, forestry, and energy production in Minnesota and worldwide.

Soil 5610. Soil Biology. (4 cr; prereq sr or grad)

Soil environment and its biological population. Role of living organisms in soil-plant environment and mineral transformations of agronomic importance. Effects of soil microflora on soil fertility and plant nutrition.

Soil 5710. Forest Soils. (3 cr; prereq 1020, FR 5114)

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

Statistics (Stat)

Stat 3011. Statistical Analysis. (4 cr; prereq college algebra)

Descriptive statistics; elementary probability; estimation; one- and two-sample tests; correlation; regression; ANOVA; randomized blocks; multiple comparisons; factorial experiments; multiple regression; goodness of fit; nonparametric methods; contingency tables; selected topics.

Stat 3012. Statistical Analysis. (4 cr; prereq 3011)
See Stat 3011.

Stat 5021. Statistical Analysis. (5 cr, §3012; prereq college algebra)

Intensive version of Stat 3011 and 3012. Primarily for graduate students needing statistics as a research technique.

This is the Administration and Faculty section of the 1996-1999
University of Minnesota College of Natural Resources Bulletin.

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⁶ Associate member from Division of Recreation, Park, and Leisure

⁷ Associate member from Department of Biosystems and Agricultural Engineering

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¹⁵ from Minnesota Department of Natural Resources

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