COURSES IN THE ENVIRONMENT

A Student Guide to
Courses in the Environment
on the Minneapolis and St. Paul Campuses
1985-86

Center for Urban and Regional Affairs
University of Minnesota
1927 S. Fifth Street
Minneapolis, MN 55454

UNIVERSITY OF MINNESOTA
TWIN CITIES

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This CURA guide is designed to provide helpful information for faculty and students during the advising and course selection process. Copies are being made available to all departments included in the listing, all listed contact faculty, all counseling offices, all college offices, and to the registration offices. Copies are in limited supply so please make them as available as possible to interested students and faculty.

Our plan is to make an updated version of this guide available every year by utilizing a computerized file for easy update and revision.

Please contact me if you have any comments or questions.

Sincerely,

Thomas L. Anding
Associate Director

TLA/cm

GENERAL INFORMATION

Courses in the Environment is intended to be a guide for faculty and students and is supplemental to official University bulletins of the various centers, colleges, and institutes of the University of Minnesota.

In the broadest sense, a very large number of courses and programs at the University have implications for environmental quality. It was necessary, however, to set some limits on what would be included in the student guide. There is no environmental studies department at the University and no formal undergraduate degree program in environmental studies. However, there are programs in the College of Liberal Arts and University College in which students can design their own environmental studies major. For information about CLA's special learning opportunities and individualized programs contact the Office for Special Learning Opportunities, 220 Johnston Hall (373-7550). For information about UC's degree programs contact the Inter-College Program, 213 Temporary North of Appleby (376-1253), or the University Without Walls, 201 Wesbrook Hall (373-3919).

Part I of this guide provides a subject index which is designed to aid students interested in pursuing an interdisciplinary area of environmental study. While some courses are obviously found in a certain department, it is frequently difficult for students interested in a particular environmental problem to be aware of all the courses available throughout the various collegiate units which pertain to the particular area of interest. For example, courses dealing with various aspects of energy or land use are found in several departments and described in various University bulletins. The subject index identifies such topical areas and steers interested students to the appropriate courses in various colleges and departments. All courses listed in Part I are described in Part II.

Part II of this guide provides environmental course descriptions according to department headings and, in most instances, the name of an individual who is prepared to advise students desiring more information about environmental courses. Several collegiate units offer, through their departments, degree programs that include a primary concentration on environmental studies. Part II is designed to serve as a guide to students pursuing an environmental studies emphasis within a given departmental major or minor. Students interested in exploring the full extent of degree programs and course offerings in a specific department should consult the appropriate college bulletin.

Part III of this guide provides a listing of special centers and services, and libraries. The special centers and services section lists organizations in the Twin Cities that participate in environmentally related activities and are frequently engaged in research and other projects in which interested students, faculty members, and others might become involved. Although these various centers do not offer classes, in some cases students may obtain credit for work completed in such outside activities. The libraries section lists Twin Cities area libraries that have collections with an environmentally related emphasis.

COURSE ABBREVIATIONS AND SYMBOLS

Departmental prefix - abbreviation indicating name of department (e.g., Geog for Geography)

Course Number - four digit figure denoting the course (e.g., 5002)

\+ all courses preceding this sign must be completed before credit will be granted for any quarter of the sequence

~ credit will not be granted if equivalent course listed after section mark has been taken for credit

{ concurrent registration allowed with course listed after this mark

consent of instructor is required for registration

^ consent of department of school offering the course is required for registration

f,w,s,su - following a course number indicate fall, winter, spring, or summer quarters

PART I: SUBJECT INDEX

SUBJECT AREAS

BIOLOGICAL PEST AND DISEASE CONTROL

Ent

1005. ECONOMIC ENTOMOLOGY.
(4 cr;prereq Biol 1009 or #)

5050. FOREST ENTOMOLOGY.
(4 cr;prereq any two courses among the forestry, zoological, botanical, biological and/or agricultural sciences)

5130. AQUATIC ENTOMOLOGY.
(5 cr;prereq 3175 or 5020 or equiv or #;offered at Itasca)

5210. INTEGRATED PEST MANAGEMENT
(5 cr;prereq 1005 or #, {5211, {5212)

5213. BIOLOGICAL CONTROL ON INSECTS.
(2 cr;prereq 5210,introductory entomology and course in ecology)

5250. PRINCIPLES OF ECONOMIC ENTOMOLOGY.
(4 cr;prereq 15 cr biological sciences and entomology incl 1005 or #;offered 1984-85 and alt yrs)

8305. INSECT ECOLOGY.
(3 cr;prereq 5400 or #)

PlPa

1001f,w. INTRODUCTORY PLANT PATHOLOGY.
(6 cr, 5050;prereq soph, 9 cr plant science)

5002f,w. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.
(6 cr, 1001, 505, prereq 14 cr plant sciences or #)

5007s.NEMATODES AND ABIOTIC AGENTS IN PLANT DISEASE.
(4 cr;prereq 20 credit hours in biology, including biochemistry and plant physiology;offered spring quarter, yearly)

5050s.FOREST PATHOLOGY.
(4 cr, 1001;prereq Biol 1103 or equiv)

8003s.PLANT DISEASE THEORY III, POPULATIONS.
(4 cr;prereq PlPa 5005, 5006, 5007 or #, and 8001, 8002; spring quarter yearly)

CULTURE, SOCIETY, AND ENVIRONMENTAL PROBLEMS

Anth

5115. ECONOMIC ANTHROPOLOGY.
(4 cr;prereq 1102 or 5102, 3201 or #)

5116. CULTURAL ECOLOGY.
(4 cr;prereq 1101, 1102 or 5102, one ethnographic area course or #)

5117. ENERGY, RESOURCE USE, AND SYSTEM CHANGE
(4 cr)

Arch

3001f.ENVIRONMENTAL DESIGN: PEOPLE AND ENVIRONMENT.
(4 cr, ~LA 3001)

3002w.ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES.
(4 cr, ~LA 3002; prereq 3001)

3003s.ENVIRONMENTAL DESIGN: IMPLEMENTATION AND EVALUATION.
(4 cr, ~LA 3003; prereq 3002)

Geog

3361. ENVIRONMENTAL EVALUATION AND ADAPTATION.
(4 cr ~3344)

Hist

3828. AMERICAN ATTITUDES TOWARD ENERGY AND ECOLOGY, 1945-PRESENT.
(4 cr)

HSci
5311. TECHNOLOGY IN AMERICAN LIFE AND THOUGHT
(4 cr)
Hum
3625. SCIENCE AND THE HUMANITIES.
(4 cr;prereq jr or sr or #)
3663. IDEAS OF NATURE: ENGLAND AND AMERICA TO 1875.
(4 cr;prereq jr or sr or #)
Rhet
1310. HUMANITIES: THE LAND IN AMERICAN EXPERIENCE.
(4 cr)
Soc
3551f,w. WORLD POPULATION PROBLEMS.
(4 cr)

EARTH SCIENCES

FR
5262. REMOTE SENSING OF NATURAL RESOURCES.
(4 cr)
Geog
1401. PHYSICAL GEOGRAPHY.
(5 cr, ~NSci 1501)
3441f.LANDFORM GEOGRAPHY.
(4 cr)
3551. INTRODUCTION TO REMOTE SENSING.
(5 cr;prereq 8 cr in geography or #)
Geo
1001f,w,s. PHYSICAL GEOLOGY.
(5 cr; 4 lect hrs and one 2-hr lab per wk)
1007s.ENVIRONMENTAL GEOLOGY.
(4 cr;prereq 1001)
1111s.INTRODUCTORY PHYSICAL GEOLOGY.
(5 cr;prereq high school or college chemistry or #;3 lect hrs, 1 rec hr, and two 2-hr labs per wk)
1601. OCEANOGRAPHY.
(4 cr; 3 lect and 1 lab hrs per wk)

Geo
5002. STRUCTURAL GEOLOGY.
(4 cr, ~5201;prereq 3401 or 5004, #;not open to geology, geophysics, geo-engineering, or mineral engineering majors)
5004. MINERALOGY.
(4 cr, ~3401;prereq Math 1221, 1 term college chemistry, #;not open to geology, geophysics, and geological, or mineral engineering majors)
5108w.ADVANCED ENVIRONMENTAL GEOLOGY.
(4 cr;prereq geol core courses 1111 through 3103 or equiv or #)
5251s.GEOMORPHOLOGY.
(4 cr [5 cr with term project];prereq 1001, Math 1111 or #; 3 lect,2 lab hrs per wk..lab often used for field trips)

ENERGY USE

Arch
3064-3065. ENVRIONMENTAL MANAGEMENT AND CONTROL.
(5cr per qtr;prereq Arch major or adult spec.,3062,3083 or #; 4 lect hrs/wk)
Arch
5173. ENERGY AND URBAN FORM.
(3 cr; prereq Arch major or adult special, 5171 or #; 3 lect hrs per wk)
5958. ENERGY AND ARCHITECTURE.
(4 cr;prereq Arch major or adult special, 3093 or #; 4 lect hrs per wk)
CE
5212. TRANSPORTATION PRODUCTIVITY AND ENERGY CONSERVATION.
(4 cr;prereq #)
Geo
1005w.GEOLOGIC PERSPECTIVES ON ENERGY.
(4 cr; 4 lect hrs per wk)
ME
5712. SOLAR ENERGY UTILIZATION.
(4 cr;prereq IT student or grad, 5342 or #; 4 lect hrs per wk)
5721. PROPULSIVE SYSTEMS FOR SURFACE TRANSPORTATION.
(4 cr;prereq IT student or grad, 3301 recommended;4 lect hr/wk)

IEOR

5710. TRANSPORT SYSTEMS ANALYSIS AND DESIGN.
(4 cr;prereq IT sr engineering status or grad; 3 lect and 1 rec hrs per wk)

5711. TRANSPORT SYSTEMS ANALYSIS AND SESIGN.
(4 cr;prereq IT sr engineering status or grad, 5710, 3 lect and 1 rec hrs per wk)

PA

5711. ENERGY POLICY I.
(3 cr)

5712. ENERGY POLICY II.
(3 cr)

ENVIRONMENT, TECHNOLOGY, AND PUBLIC POLICY

LA

5227. IMPACT ASSESSMENT AND ENVIRONMENTAL MEDIATION.
(5 cr;prereq Senior or grad or #)

Biol

3051su.BIOLOGY AND THE FUTURE OF MAN.
(4 cr;S-N only)

5951. SOCIAL USES OF BIOLOGY.
(4 cr,S-N only;prereq 10 cr sciences)

BGS

8010. BUSINESS AND GOVERNMENT II: GOVERNMENT SOCIAL REGULATION OF BUSINESS.
(4 cr;prereq MBA 8055, grad mgmt IR student or # and Grad Sct Mgmt approval)

CE

5580. INTRODUCTION TO ENVIRONMENTAL LAW FOR ENGINEERS.
(3 cr;3 lect hrs per wk)

5581. ENVIRONMENTAL LAW.
(4 cr;prereq 5580)

Geog

3355. ENVIRONMENTAL PROBLEMS.
(4 cr)

ID

3970. DIRECTED STUDIES.
(3-15 cr per qtr;prereq OSLO approval, ^)

5402. ECOLOGY, TECHNOLOGY, AND SOCIETY.
(4 cr per qtr)

Jour

5133. INTERPRETIVE REPORTING ABOUT SCIENCE.
(4 cr;prereq 3121 or #, ^)

5143. INTERPRETATION OF SCIENCE AND TECHNOLOGY.
(4 cr;prereq professional journalism major status,5133 or #,^)

Law

5215. ENVIRONMENTAL REGULATION.
(3 cr)

ME

5402. ECOLOGY, TECHNOLOGY, AND SOCIETY.
(4 cr, ~SSci 3402;prereq IT student of grad; 4 lect hrs per wk)

IEOR

5701. TECHNOLOGY ASSESSMENT.
(4 cr;prereq upper dividion; 4 lect hrs per wk)

Pol

5623. THE POLITICS OF THE REGULATORY PROCESS.
(4 cr,prereq 1001 or equiv or #)

PA

5701,5702. TECHNOLOGY PLANNING I AND II.
(3 cr each)

5721. ENVIRONMENTAL POLICY.
(3 cr)

8701-09. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY.
(3 cr)

RCD

1010. ISSUES IN THE ENVIRONMENT.
(3 cr)

5120. ENVIRONMENTAL PROBLEMS.
(3 cr, ~1010)

Rhet

5700. COMMUNICATION IN TECHNOLOGICAL AND ENVIRONMENTAL IMPACT ASSESSMENT.
(4 cr;prereq sr or grad standing, one course in statistics, #)

ENVIRONMENTAL HEALTH AND POLLUTION CONTROL

ChEn

5751-5752-5753. BIOLOGICAL ENGINEERING ANALYSIS.
(3 cr per qtr;prereq #; 3 lect hrs per wk)

5801. AIR POLLUTION CONTROL ENGINEERING.
(4 cr; 4 lect hrs per wk)

CE

3500. INTRODUCTION TO ENVIRONMENTAL ENGINEERING PROBLEMS AND ANALYSIS.
(4 cr;prereq Chem 1005)

5510. SOLID WASTE MANAGEMENT.
(4 cr)

5511. HAZARDOUS WASTE ENGINEERING.
(4 cr;prereq 5510 or #; 3 lect and 2 lab hrs per wk)

EBB

5612. BIOGEOCHEMICAL CYCLES.
(3 cr;prereq Biol 3041, Biol 5001, or MicB5321 or #)

5613. ASSESSING THE ECOLOGICAL EFFECTS OF POLLUTION.
(4 cr;prepre Biol 5041 or equiv, Chem 3301, 3302)

PubH

3151. INTRODUCTION TO ENVIRONMENTAL HEALTH.
(3 cr)

5151. ENVIRONMENTAL HEALTH.
(3 cr;prereq #)

5152. ENVIRONMENTAL HEALTH.
(2 cr)

5156. ENVIRONMENTAL HEALTH I.
(2 cr;prereq environmental health student or #)

5157. ENVIRONMENTAL HEALTH II.
(2 cr;prereq environmental health student or #)

5171. ENVIRONMENTAL MICROBIOLOGY.
(3 cr;prereq MicB 3103 or #)

5172. ENVIRONMENTAL MICROBIOLOGY LABORATORY.
(2 cr;prereq 5171, #)

5177. PUBLIC HEALTH BIOLOGY.
(3 cr;prereq environmental health students only or #)

5181. AIR POLLUTION.
(3 cr;prereq general chemistry or #)

PubH

5184. AIR ANALYSIS.
(3 cr/prereq 5211, #)

5201. RADIATION PROTECTION AND MEASUREMENT.
(2 cr,lect only, 3 cr lect and lab)

5202. NUCLEAR POWER AND THE ENVIRONMENT.
(2-3 cr;prereq 5201 or #)

5253. INTRODUCTION TO HAZARDOUS WASTE MANAGEMENT.
(3 cr)

5261. GENERAL ENVIRONMENTAL TOXICOLOGY.
(3 cr)

5265. APPLIED ENVIRONMENTAL TOXICOLOGY.
(3 cr;prereq 5261 or #)

FR

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

ME

5609. AIR POLLUTION.
(4 cr;prereq IT student or grad, 3303 or #; 4 lect hrs per wk)

5612. ENVIRONMENTAL ENGINEERING.
(4 cr;prereq IT student of grad, 3303; 4 lect hrs per wk)

MinE

5710. ENVIRONMENTAL ASPECTS OF MINERAL ENGINEERING.
(4 cr;prereq 3rd yr IT or #; 4 lect hrs per wk)

FISH AND WILDLIFE

EBB

5606. ECOLOGY OF FISHES.
(5 cr;prereq Biol 1009 or 1106 or equiv plus 10 cr in the biological sciences;offered 1984-85 and alt yrs)

5817s,su. VERTEBRATE ECOLOGY.
(5 cr;prereq course in ecology,#,^)

5834s,su. FIELD ORNITHOLOGY.
(5 cr;prereq Biol 1106,^;offered annually)

FW

1002. WILFLIFE FOR NONMAJORS: ECOLOGY, VALUES AND HUMAN IMPACT.
(3 cr)

FW

3052. INTRODUCTION TO FISHERIES AND WILDLIFE BIOLOGY AND MANAGEMENT.
(4 cr;prereq Biol 5041;3 lect, 1 demonstration-discussion per wk)

3157. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.
(1 cr;offered at Cloquet)

5451. ECOLOGY OF FISH POPULATIONS.
(5 cr;prereq Biol 5041 or equiv, EBB/Geo 5601, EBB 5136, Stat 5022 or equiv or #)

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

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

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

5457. WATER QUALITY MANAGEMENT: FISHERIES.
(2 cr;5457-5458+, ~FR 5457;prereq Chem 1005 or equiv)

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

5562. WILDLIFE ECOLOGY, MANAGEMENT II: POPULATIONS.
(4 cr;prereq 5561 or #)

5563. WILDLIFE ECOLOGY, MANAGEMENT III: HABITATS.
(3 cr;prereq sr standing or #)

5564. WILDLIFE ECOLOGY, MANAGEMENT IV: FIELD PROBLEMS IN WILDLIFE RESOURCE MANAGEMENT.
(4 cr;prereq sr wildlife major or #)

FR

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

VB

5330. WILD BIRD MEDICINE.
(2 cr;prereq regis vet med, 3rd or 4th year or grad student or #)

VPB

5603s. PARASITES OF WILDLIFE.
(3 cr;prereq #;offered 1985 and alt yrs)

5640s. DISEASES OF WILDLIFE.
(3 cr;offered 1984 and alt yrs)

FOREST MANAGEMENT

FR

1200. INTRODUCTION TO FOREST RESOURCES.
(3 cr)

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

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

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

3220. BEGINNING FOREST SOILS.
(2 cr;prereq Itasca session, Geo 1001)

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

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

5110. FOREST WATER QUALITY MANAGEMENT.
(4 cr;prereq 5114, Itasca session, or #)

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

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

5126. FIELD FOREST SOILS.
(2 cr;prereq 3220, 5114;given at Cloquet)

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

5153. ADVANCED FOREST HYDROLOGY.
(4 cr;prereq 3220, 5114 or #)

5222. FOREST POLICY AND ECONOMICS.
(5 cr or cr ar, ~5265;prereq AgEc 1030 or #)

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

5261. ADVANCED FOREST POLICY AND ECONOMICS.
(3 cr;prereq 5222 or #)

5265. FOREST POLICY ISSUES.
(3 cr, ~5222)

FR

5408. FORESTRY IN THE URBAN ENVIRONMENT.
(3 cr;prereq student teacher, teacher or #)

5500. URBAN FOREST MANAGEMENT.
(3 cr;prereq 5100 or #)

8103. RESEARCH PROBLEMS: FOREST HYDROLOGY.
(Cr ar)

8213. TOPICS IN WILDLIFE HYDROLOGY.
(3 cr;prereq 5114, CE 5405 or #;offered alt yrs)

LAKES AND WETLANDS

Bot

5231s. INTRODUCTION TO THE ALGAE.
(5 cr;prereq 10 cr in botany or biology or #;offered 1984-85 and alt yrs)

5805su.AQUATIC FLOWERING PLANTS.
(5 cr;limited to 20 students;prereq course in taxonomy,^)

5811su.FRESHWATER ALGAE.
(5 cr;limited to 20 students;prereq 10 cr botany,biology or zoology, ^; offered annualy)

CE

8430. LAKE AND RESERVOIR HYDRODYNAMICS.
(3 cr;prereq #)

EBB

5601. LIMNOLOGY.
(4 cr,~Geo 5601;prereq Chem 1005 or #)

5603. PLANKTON POPULATIONS.
(5 cr;prereq 5601 or 5812, Biol 3041 or #;offered 1984-85 and alt yrs)

5604. BIOLOGICAL LIMNOLOGY.
(3 cr;prereq 5601 or 5612 or #)

5605. LABORATORY IN BIOLOGICAL LIMNOLOGY.
(2 cr;prereq 5601 or 5812 or #)

5607. ECOLOGY OF ANIMAL PLANKTON.
(4 cr;prereq Biol 5041, EBB 5601 or #)

5611. LINMOLOGY LABORATORY.
(2 cr;prereq EBB 5601 or Geol 5601 or #)

EBB

5812su.AQUATIC ECOLOGY.
(5cr;limited to 20 students;prereq 15 cr biology, 5 cr chemistry,^;offered annually)

5820su.WETLAND ECOLOGY.
(10 cr;limited to 15 students;prereq 15 cr biology,^;introductory chemistry, course in plant identification, Biol 3041 recommended)

Geo

5601f. LIMNOLOGY.
(4 cr, ~EBB 5601;prereq Chem 1005 or equiv)

5602f. CASE STUDIES IN LIMNOLOGY.
(3 cr;prereq 5601 or EBB 5601 and #)

5603w. GEOLOGICAL LIMNOLOGY.
(4 cr;prereq 5601 or EBB 5601)

8602. ADVANCED LIMNOLOGY.
(3 cr;prereq 5601 or equiv, #;offered 1985-86 and alt yrs)

LAND USE

AgEc

5130. LAND RESOURCE USE.
(3 cr; not open to majors in AgEc Dept; prereq 1020, 1030)

5600. LAND ECONOMICS.
(4 cr for undergrad, 3 cr for grad; prereq 3101, 3102, or Econ 3101, 3102 or #)

5610. LAND USE INSTITUTIONS OF LOCAL GOVERNMENT.
(4 cr for undergrad, 3 cr for grad; prereq 1020, 1030)

8360. SEMINAR: LAND ECONOMICS AND TENURE.
(3 cr; offered when demand warrants)

LA

8370. URBAN OPEN SPACE PRESERVATION AND REGENERATION.
(2 cr;prereq MLA student or #)

Geog

3344. GEOGRAPHY AND LAND USE DECISIONS.
(4 cr)

8340. SEMINAR: LAND USE PLANNING.
(1-3 cr;prereq #)

Geog

8344. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.
(1 cr;prereq #)

8345. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.
(3 cr;prereq 8344)

Law

5201. LAND USE PLANNING.
(3 cr)

PA

5540. DEVELOPMENT MANAGEMENT SYSTEMS.
(3 cr)

5601. LAND USE.
(3 cr)

8600. SEMINAR: LAND USE PLANNING.
(3 cr)

8601-09. WORKSHOP/SEMINAR: ADVANCED TOPICS IN LAND USE AND HUMAN SETTLEMENTS.
(3 cr)

LIFE SCIENCES

Biol

1009. (formerly 1011) GENERAL BIOLOGY.
(5 cr;prereq ~1011)

1102f,w. MICROBES AND MAN.
(4 cr)

1103f,w,s,su. GENERAL BOTANY.
(5 cr, ~3012;prereq 1009; students who plan to major in biology in CLA or in any bioscience major in CBS should take 3012)

1106f,w,s,su. GENERAL ZOOLOGY.
(5 cr;prereq 1009)

30011f,w,s,wu. ANIMAL BIOLOGY.
(5 cr, ~1106;prereq 1009, Chem 1005)

3012f,w,s. PLANT BIOLOGY.
(5 cr, ~1106;prereq 1009, Chem 1005)

3042f,w,s. FIELD PROBLEMS IN ECOLOGY.
(2 cr;prereq 3041 or EBB 3004 or #)

Biol

5041. (formerly 3041) ECOLOGY.
(4 cr;prereq Math 1142 or 1211, Biol 1103, 1106 or 3011 or 3012)

EBB

3001. INTRODUCTION TO ECOLOGY.
(4 cr;open to jrs and above but not to biology majors)

3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS.
(4 cr,~3001;not open to biology majors;prereq Math 1231)

5051. ANALYSIS OF POPULATIONS.
(4 cr,~8001;prereq 3004 or Biol 3041 or #)

5052. THEORETICAL POPULATION ECOLOGY.
(4 cr;prereq Biol 3041 or #)

5053. THEORY OF STRUCTURED POPULATIONS.
(4 cr,prereq Math 1231, Biol 5041 or equiv, EBB5052 or equiv)

5112. INVERTEBRATE BIOLOGY.
(5 cr;prereq Biol 1106 or 3011 or #;offered 1984-85 and alt yrs)

5114w. VERTEBRATE BIOLOGY.
(4 cr;prereq Biol 1106 or 3011)

5608f. ECOSYSTEMS: FORM AND FUNCTION.
(3 cr;prereq 5601 or Biol 5041, Chem 1002 or 1005;offered 1983-84 and alt yrs)

3800su. INTRODUCTION TO FIELD RESEARCH.
(10 cr;limited to 20 students;prereq two courses in biology,^;hrs ar)

Ent

5400. EXPERIMENTAL ECOLOGY.
(3cr;prereq 9 cr biology or equiv, 3 cr animal or plant ecology or #)

8300. EXPERIMENTAL ECOLOGY LABORATORY.
(2 cr;prereq 5400 or {5400)

MicB

1101. ELEMENTARY MICROBIOLOGY.
(4 cr;prereq Biol 1009 or {Biol 1009 or equiv;intended for students in CLA, dental hygiene, physical therapy, mortuary science, others with #;not intended for majors)

3103w. GENERAL MICROBIOLOGY.
(5 cr, ~5105, ~Biol 5013, ~VPB 3103;prereq soph with C avg in courses prereq to major sequence, or jr with 10 cr chemistry and 5 cr biological sciences or #)

MicB
5611f. MICROBIAL ECOLOGY.
(4 cr;prereq general microbiology course, Biol 5001 or #)

METEOROLOGY AND CLIMATOLOGY

FR
3103. METEOROLOGY AND CLIMATOLOGY FOR RESOURCE MANAGERS.
(2 cr;prereq Phys 1001, Phys 1005 or #)
Geog
1425. INTRODUCTION TO METEOROLOGY.
(4 cr, ~Soil 1262)
3421. CLIMATOLOGY.
(4 cr;prereq 1401 or #)
5423w. ADVANCED CLIMATOLOGY.
(4 cr;prereq 3421 or #)
5424. APPLIED CLIMATOLOGY.
(3 cr, ~Soils 5424;prereq Geog 3421 or Soils 5420 or #)
8420. SEMINAR: CLIMATOLOGY.
(1-3 cr;prereq #)
Phys
1071. INTRODUCTORY METEOROLOGY.
(4 cr;prereq high school algebra; 4 lect hrs per wk)
1075. INTRODUCTORY METEOROLOGY LABORATORY.
(1 cr; S-N only;prereq 1071 or {1071;2 lab hrs per wk)
5441. INTRODUCTORY DYNAMIC METEORLOGY I.
(5 cr;prereq 1291 and Math 3231 or 5602 or #;3 lect and 3 lab hrs per wk)
5442. INTRODUCTORY DYNAMIC METEOROLOGY II.
(4 cr;prereq 5441 or #)
5451. CLOUD PHYSICS.
(3 cr;prereq Math 3211 or equiv, 1 yr general physics; 3 lect hrs per wk)
5452. CLOUD SYSTEMS.
(3 cr;prereq Math 3211 or equiv, 1 yr general physics; 3 lect hrs per wk)

Phys
5453. ELECTRICAL PROPERTIES OF CLOUDS.
(3 cr;prereq Math 3211 or equiv, 1 yr general physics; 3 lect hrs per wk)
5461. PHYSICS AND CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE.
(4 cr;prereq general physics and calculus)
Soil
1262. INTRODUCTION TO METEOROLOGY.
(4 cr)
5240. MICROCLIMATOLOGY (SOILS).
(5 cr;prereq Math 1111, 10 cr physics or #)
Soil
5424. APPLIED CLIMATOLOGY.
(3 cr;prereq 5140 or Geog 3421 or #)

NATURALIST STUDIES

Bot
1009s. MINNESOTA PLANT LIFE.
(4 cr; suitable for nonmajors)
1012f. PLANTS USEFUL TO MAN.
(4 cr; for majors or nonmajors)
3201w. INTRODUCTORY TAXONOMY.
(4 cr;prereq Biol 1103 or 3012)
5205s. FLORA OF MINNESOTA.
(4 cr;prereq 3201 or #)
5801su. PLAINS AND BOREAL FLORA.
(5 cr;limited to 20 students;prereq course in taxonomy,^;offered annually)
5815su. BRYOPHYTES.
(5 cr;limited to 20 students;prereq 10 cr biology or #, ^; offered when feasible)
5821su.LICHENS.
(5 cr;limited to 20 students;prereq 10 cr in botany or zoology or #, ^;offered 1984 and alt yrs)
5825. BIOLOGY OF THE FERNS.
(5 cr;prereq ^;offered when feasible)

EBB

5014. ECOLOGY OF PLANT COMMUNITIES.
(5 cr;prereq 3004 or Biol 3041, 1 qtr statistics or #)

5016. ECOLOGICAL PLANT GEOGRAPHY.
(5 cr;prereq 3004 or Biol 3041, Bot 3201;offered 1984-85 and alt yrs)

5122. PLANT/ANIMAL INTERACTIONS.
(4 cr;prereq Biol 3011, 3012 or #)

5129. MAMMALOGY.
(5 cr, ~FW 5129; prereq Biol 1106 or 3011 or #)

5132. HERPETOLOGY.
(5 cr;prereq Biol 1106 or 3011 or #;offered 1984-85 and alt yrs)

5134. INTRODUCTION TO ORNITHOLOGY.
(5 cr;prereq Biol 1106 or 3011)

5136. ICHTHYOLOGY.
(4 cr;prereq 15 cr incl Biol 1106 or 3011)

5814su.COMMUNITY STRUCTURE AND FUNCTION.
(5 cr;limited to 20 students;prereq course in ecology,^;offered annually)

Ent

3175. INTRODUCTORY ENTOMOLOGY.
(5 cr;prereq Biol 1009 or equiv)

5020. FIELD ENTOMOLOGY.
(5 cr;prereq introductory biology;offered SSI at Itasca)

FR

3100. IMPORTANT FOREST PLANTS.
(2 cr;prereq Biol 1103; given at Itasca)

Geog

3431. INTRODUCTION TO PLANT AND ANIMAL GEOGRAPHY.
(4 cr;not open to biology majors)

OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

AEM

5687. INTRODUCTION TO ACOUSTICS AND ENVIRONMENTAL NOISE.
(4 cr;prereq Phys 1291, Math 3221 or equiv; 3 lect and 1 lab period per week)

CDis

5704. NOISE AND MAN.
(4 cr;prereq 5301 or #)

PubH

5194. OCCUPATIONAL SAFETY.
(2 cr)

5211. INDUSTRIAL HYGIENE ENGINEERING.
(3 cr)

5212. VENTILATION CONTROL OF ENVIRONMENTAL HAZARDS.
(3 cr;prereq 5211, #)

5214. AGRICULTURAL OCCUPATIONAL HEALTH.
(3 cr)

5215. APPLIED OCCUPATIONAL TOXICOLOGY.
(3 cr;prereq 5261 or #)

5231. ENVIRONMENTAL HEALTH AND SAFETY IN HEALTH CARE FACILITIES.
(4 cr;prereq #)

5233. BIOHAZARD CONTROL IN BIOMEDICAL LABORATORIES.
(2 cr;prereq #)

5267. ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY.
(3 cr)

5603. THERMAL ENVIRONMENTAL ENGINEERING.
(4 cr;prereq IT student of grad, 3303 and 5342 or equiv; 4 lect hrs per wk)

ME

5607. INDUSTRIAL VENTILATION AND CONTAMINANT CONTROL.
(4 cr;prereq IT student or grad, 3303 and CE 3400 or equiv; 4 lect hrs per wk)

5615. AIR CONTAMINANT MEASUREMENT.
(4 cr;prereq IT student or grad, 5613 or #)

RECREATION AND OUTDOOR EDUCATION

LA

5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.
(4 cr, ~FR 5233; 4 lect hrs per wk)

5105. RECREATIONAL PLANNING AND DESIGN.
(6 cr;prereq 5010; 2 lect and 12 lab hrs per wk)

Elem

5348su.WORKSHOP: OUTDOOR SCIENCE EDUCATION.
(3 cr;prereq elementary tchg exper)

FR

3232. MANAGEMENT OF RECREATIONAL LANDS.
(3 cr;prereq #)

5233. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.
(4 cr;prereq 5232 or #)

5236. FOREST RECREATION PLANNING.
(1 cr;prereq 5232;given at Cloquet)

5257. RECREATION LAND POLICY.
(3 cr;prereq 5232 or #)

5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR.
(3 cr;prereq 5232, RRM major or grad student or #)

5406. FORESTRY WORKSHOP FOR TEACHERS.
(5 cr)

Rec

5160. CONSERVATION OF PARK RESOURCES.
(3 cr;prereq 1520 or 5100 or ^)

5250. FINANCING LEISURE SERVICES.
(3 cr;prereq 3550 or ^)

5300. FOUNDATIONS OF OUTDOOR EDUCATION.
(3 cr;prereq sr, 1520 or 5100 or #)

5310. PROGRAMMING IN OUTDOOR EDUCATION.
(4 cr;prereq 5300 or #)

5350. WILDERNESS OUTDOOR RECREATION PROGRAMMING.
(4 cr;prereq 3150, fitness test of running 2 miles in under 17 minutes, or #)

5900. WORKSHOP: CONTEMPORARY ISSUES IN LEISURE SERVICES.
(1-12 cr [max 12 cr];prereq ^)

RESOURCE MANAGEMENT

AgEc

3610. COMMUNITY RESOURCE DEVELOPMENT.
(4 cr; prereq 1020-1030 or Econ 1001-1002 or #)

AgEc

5650. ECONOMICS OF NATURAL RESOURCE POLICY.
(4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)

8264. RESOURCE ECONOMICS.
(3 cr, prereq Econ 5162 or (Econ 5162 or #)

8364. SEMINAR: RESOURCE ECONOMICS AND POLICY.
(3 cr; offered when demand warrants)

LA

8350. SMALL COMMUNITY PLANNING AND THE CONSERVATION OF NATURAL RESOURCES.
(2 cr;prereq MLA student or #)

BGS

3003. BUSINESS AND THE NATURAL ENVIRONMENT.
(4 cr;prereq jr or sr)

Econ

5611. ECONOMICS OF ENVIRONMENTAL CONTROL.
(4 cr;prereq 1001, 1002 or equiv)

FR

1201. CONSERVATION OF NATURAL RESOURCES.
(3 cr)

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

Geog

3345f. ENERGY AND MINERALS.
(4 cr)

3351. FOOD PRODUCTION AND DISTRIBUTION.
(4 cr)

5344. HISTORICAL GEOGRAPHY OF RESOURCE USE IN THE UNITED STATES.
(4 cr;prereq 3101 or 3344 or grad)

RCD

3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY.
(1 cr, ~Soil 3118; S-N only; offered fall 1984 and alt yrs)

5099. RCD INTERDISCIPLINARY SEMINAR I.
(4 cr, 5099-5100+, ~RCD 5099, ~AgEc 5099, ~AgET 5099, ~Soil 5099;prereq resource and community development sr or #)

5100. RCD INTERDISCIPLINARY SEMINAR II.
(4 cr, 5099-5100+, ~RCD 5100, ~AgEc 5100, ~AgEt 5100, ~Soil 5100;prereq 5099 or #)

RCD

5200. COMMUNITY DEVELOPMENT SIMULATION.
(4 cr for undergrad, 3 cr for grad; prereq #)

Soil

5104. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING.
(4 cr, ~PlPa 5104, ~AgEc 5104, ~AnSc 5104; prereq Math 1142 or #)

SOIL RESOURCES

AgET

5400. DRAINAGE AND IRRIGATION.
(4 cr, prereq Soil 3210; 3 lect and 2 lab hrs per wk)

AgEn

5540. EROSION CONTROL, WATERSHED ENGINEERING.
(4 cr; prereq IT upper division or grad IT major, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)

5550. DRAINAGE AND IRRIGATION ENGINEERING.
(4 cr;prereq IT upper division or grad IT major, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)

Geog

3451. GEOGRAPHY OF SOILS.
(4 cr, ~Soil 5512)

Soil

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

3118. SEMINAR: SOIL POLLUTION AND PUBLIC POLICY.
(1 cr; S-N only; offered fall 1986 and alt yrs)

3220. SOIL, WATER MANAGEMENT, AND CONSERVATION.
(3 cr; prereq 3210 or #)

3610. SOIL BIOLOGY.
(4 cr;prereq 1122 and PlPa 1001 or #)

5340. ORGANIC AND PESTICIDAL RESIDUES.
(5 cr;prereq 1122, sr or #)

5532. SOILS AND THE ECOSYSTEM.
(5 cr;may be taken in place of EBB 5819;prereq course in ecology;offered at Itasca in summer)

5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.
(3 cr;prereq 1122 or #)

Soil

5560. USES AND INTERPRETATION OF SOIL SURVEY INFORMATION.
(3 cr;prereq 3520 or #)

5570. FIELD TOUR OF MINNESOTA SOILS.
(3 cr;prereq 3520 or #)

WATER RESOURCES

AgET

3410. HYDROLOGY, WATER CONTROL.
(4 cr; prereq Math 1111, Phys 1041, Soil 1122; 3 lect hrs, 1 hr rec per wk)

AgEn

8500. HYDROLOGIC MODELING - SMALL WATERSHEDS.
(4 cr;prereq CE 5405, grad It major; 3 lect and 1 rec hrs per wk)

CE

5401. WATER RESOURCES ENGINEERING.
(4 cr;prereq IT or grad student, 3400 or #; 3 lect and 3 lab hrs per wk)

5405. HYDROLOGY AND HYDROLOGIC DESIGN.
(4 cr;prereq IT or grad student, 5401 or #; 3 lect and 3 lab hrs per wk)

5420. INTRODUCTION TO WATER RESOURCES MANAGEMENT.
(4 cr)

5425. GROUNDWATER MECHANICS.
(4 cr/prereq IT or grad student, 3400 or #)

8406. SEMINAR: ADVANCED HYDROLOGY.
(1 cr)

8419. WATER RESOURCES SYSTEMS SIMULATION.
(4 cr prereq 5401 or #)

8425. ADVANCED GROUNDWATER MECHANICS.
(4 cr;prereq 5425 or #)

Geog

5444. GEOGRAPHY OF WATER RESOURCES.
(4 cr;prereq two courses in physical geography or #)

Geo

5611. GROUNDWATER GEOLOGY.
(3 cr;prereq 1001 or 1111, Math 1231, 1 qtr physics and chemistry or #)

8603. METHODS FOR ANALYSIS OF NATURAL WATERS.
(2 cr;prereq 5601 or equiv, #)

8612. ANALYTICAL GEOHYDROLOGY.
(3 cr; [4 cr with term paper];prereq Math 3221, CE 3400 or #)

8621. TRACERS IN HYDROGEOLOGY.
(2 cr;prereq #)

WATER SUPPLY AND WATER QUALITY

AgET

3800. RURAL SANITATION AND WATER SUPPLY.
(4 cr; prereq Phys 1041, Chem 1005; 3 lect and 3 lab hrs per wk)

AgEn

5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING.
(4 cr;prereq IT upperdivision or grad IT major, 3052 or #, Chem 1005 or 1014; 3 lect and 3 lab hrs per wk)

CE

5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS.
(4 cr;prereq IT or grad student, 3400, 3500 or #)

5505. WATER QUALITY AND TREATMENT.
(4 cr; prereq IT or grad student, 3500 or #)

5506. ENVIRONMENTAL WATER CHEMISTRY.
(4 cr;prereq IT or grad student, Chem 1006 or #; 3 lect and 1 rec hrs per wk)

8510. INDUSTRIAL WASTEWATER TREATMENT AND DISPOSAL.
(3 cr;prereq #)

PubH

5241. ENVIRONMENTAL HEALTH ASPECTS OF WATER SUPPLY.
(3 cr)

5242. ENVIRONMENTAL HEALTH ASPECTS OF GROUNDWATER SYSTEMS.
(2 cr)

5243. WATER AND HEALTH.
(3 cr)

PubH

5244. ENVIRONMENTAL HEALTH ASPECTS OF WASTEWATER SYSTEMS.
(3 cr)

FW

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

FR

5458. WATER QUALITY MANAGEMENT: ECOSYSTEM APPROACHES.
(4 cr;prereq Chem 1005, 3103 or #)

PART II: COURSE LISTINGS

AEROSPACE ENGINEERING AND MECHANICS (AEM)
Institute of Technology
107 Akerman
CONTACT Department Office, 107 Akerman, 373-5010

5687. INTRODUCTION TO ACOUSTICS AND ENVIRONMENTAL NOISE.
(4 cr;prereq Phys 1291,Math 3221 or equiv;3 lec and 1 lab per wk)
Derivation of the wave equation, plane wave solution, transmission and reflection at boundaries, resonators and mufflers, three-dimensional wave propogation, properties of environmental noise sources, hearing and perception of sound, acoustical properties of rooms, laboratory experience in sound and noise measurements and noise control techniques.

AGRICULTURAL AND APPLIED ECONOMICS (AgEc)
College of Agriculture
231 Classroom Office Building
CONTACTS T. Graham-Tomasi, 316C Classroom Office Building, 376-3563
K. William Easten, 317G Classroom Office Building, 376-3800

3610. COMMUNITY RESOURCE DEVELOPMENT.
(4 cr; prereq 1020-1030 or Econ 1001-1002 or #)
Basic concepts of resource use 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.

5130. LAND RESOURCE USE.
(3 cr; not open to majors in AgEc Dept; prereq 1020, 1030)
Land as a factor of production; rural and urban utilization; rents and land values; land classification; taxation; exchange; public land management.

5600. LAND ECONOMICS.
(4 cr for undergrad, 3 cr for grad; prereq 3101, 3102, or Econ 3101, 3102 or #)
Land as a factor of production; land use, classification, and value; sale and rental markets for land; domestic and foreign land policies.

5610. LAND USE INSTITUTIONS OF LOCAL GOVERNMENT.
(4 cr for undergrad, 3 cr for grad; prereq 1020, 1030)
Introduction to law as an institution of government as applied to land use. Emphasis on regulatory powers, especially zoning, including types of permits, methods of exercising discretion, constitutional and statutory constraints, administrative procedures, growth control techniques, planned developments, exclusionary zoning, separation of powers, and judicial review. Other regulatory powers include subdivision controls, building, housing and sanitary codes, and official maps.

5650. ECONOMICS OF NATURAL RESOURCE POLICY.
(4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)
Application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.

8264. RESOURCE ECONOMICS.
(3 cr, prereq Econ 5162 or (Econ 5162 or #)
Economic analysis relevant to resource use and management; concepts of joint production and joint costs; external effects of resource decisions; applications of public finance, welfare economics, capital theory, and discount rates; cost-benefit analysis and other decision-making approaches; investment and management problems related to water resources, outdoor recreation, forestry, and fisheries; economic problems of air pollution and environmental quality.

8360. SEMINAR: LAND ECONOMICS AND TENURE.
(3 cr; offered when demand warrants)

8364. SEMINAR: RESOURCE ECONOMICS AND POLICY.
(3 cr; offered when demand warrants)

AGRICULTURAL ENGINEERING
213 Agricultural Engineering
CONTACT C.L. Larson, 207 Agricultural Engineering, 373-1331
C.J. Clanton, 810 Agricultural Engineering, 383-1383

College of Agriculture (AgET)

3410. HYDROLOGY, WATER CONTROL.
(4 cr; prereq Math 1111, Phys 1041, Soil 1122; 3 lect hrs, 1 hr rec per wk)
The hydrologic cycle-precipitation, infiltration, evaporation, surface runoff. Water table variations, subsurface runoff. Flow in open channels, flow measurement. Watershed runoff, floods. Sediment sources, erosion, and sediment control. Water control on a watershed basis.

3800. RURAL SANITATION AND WATER SUPPLY.
(4 cr; prereq Phys 1041, Chem 1005; 3 lect and 3 lab hrs per wk)
Wells, pumps, water supply, and treatment. Water supply and waste disposal systems for homes, farmsteads, resorts, and recreational use.

5400. DRAINAGE AND IRRIGATION.
(4 cr, prereq Soil 3210; 3 lect and 2 lab hrs per wk)
Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.

INSTITUTE OF TECHNOLOGY (AgEn)

5540. EROSION CONTROL, WATERSHED ENGINEERING.
(4 cr; prereq IT upper division or grad IT major, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)
Measurement and mechanics of watershed runoff and soil erosion. Estimating peak runoff, soil losses, and sediment yields. Environmental effects. Principles of small watershed planning for flood control, water storage, and sediment control. Hydraulic design of graded and storage type terraces, grass waterways, diversions, and erosion control structures.

5550. DRAINAGE AND IRRIGATION ENGINEERING.
(4 cr;prereq IT upper division or grad IT major, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)
Flow of water through agricultural soils. Irrigation and drainage requirements, salinity control, evaportranspiration, water supply development and control. Conveyance of drainage and irrigation waters. Considerations for design, layout, and construction of irrigation and drainage systems. Institutional, environmental, and economic aspects of soil moisture control.

5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING.
(4 cr;prereq IT upperdivision or grad IT major, 3052 or #, Chem 1005 or 1014; 3 lect and 3 lab hrs per wk)
Sources and characteristics of agricultural wastes including animal manures, crop residues, sediments, processing wastes, and domestic wastes. Effects on the environment. Sanitary collection, storage, treatment, and disposal. Utilization of liquid and solid wastes. Nonurban water supply and quality.

8500. HYDROLOGIC MODELING - SMALL WATERSHEDS.
(4 cr;prereq CE 5405, grad It major; 3 lect and 1 rec hrs per wk)
Study and representation of hydrologic processes by mathematical models; infiltration, overland flow, return flow, evapotranspiration, channel flow, and storage. Time-flow relationships. Linear and nonlinear methods. Frequency relationships. Emphasis on parametric methods.

ANTHROPOLOGY (Anth)
College of Liberal Arts
215 Ford Hall
CONTACT Department Office, 215 Ford Hall, 373-2601

5115. ECONOMIC ANTHROPOLOGY.
(4 cr;prereq 1102 or 5102, 3201 or #)
Systems of production and distribution, especially in nonindustrial societies. Relationship among economic and social, political, religious, psychological, and environmental factors.

5116. CULTURAL ECOLOGY.
(4 cr;prereq 1101,1102 or 5102, 1 ethnographic area course or #)
The literature of cultural ecology, biological approach to ecosystems and population studies.

5117. ENERGY, RESOURCE USE, AND SYSTEM CHANGE
(4 cr)
Social-cultural system factors in the development, production, control, distribution and use of energy, water, key resources and food in the United States and other societies. Social-cultural evolution. Interaction among different societies, growth and no-growth issues, emerging global interdepedence.

ARCHITECTURE AND LANDSCAPE ARCHITECTURE
Institute of Technology
110 Architecture
ARCHITECTURE (Arch)
CONTACT Lance LaVine, 110 Architecture, 376-4525

3001f. ENVIRONMENTAL DESIGN: PEOPLE AND ENVIRONMENT.
(4 cr, ~LA 3001)
Interaction of people and their environment using the disciplines of the natural and social sciences and the arts as resource background for readings, lectures, discussions, and workshop sessions.

3002w. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES.
(4 cr, ~LA 3002; prereq 3001)
The nature and effects of vaious tools and processes of environmental change ranging from buildings and landscapes to economic policies, climate, and myths. Readings, lectures, discussions, and workshop sessions.

3003s. ENVIRONMENTAL DESIGN: IMPLEMENTATION AND EVALUATION.
(4 cr, ~LA 3003; prereq 3002)
Design projects, discussions, and readings exploring personal abilities to implement and evaluate environmental change.

3064-3065. ENVRIONMENTAL MANAGEMENT AND CONTROL.
(5 cr per qtr; prereq Arch major or adult special, 3062, 3083 or #; 4 lect hrs per wk)
Environmental-mechanical considerations including comfort technology, space habitability, climate, psychometrics, control and management systems; waste management including plumbing systems and waste disposal techniques. Electrical systems, energy, power distribution and machinery; lighting systems, physiology of seeing, light sources and control; spatial acoustics, noise barriers, absorption.

5173. ENERGY AND URBAN FORM.
(3 cr; prereq Arch major or adult special, 5171 or #; 3 lect hrs per wk)
The role of energy as a determinant of urban form.

5958. ENERGY AND ARCHITECTURE.
(4 cr;prereq Arch major or adult special, 3093 or #; 4 lect hrs per wk)
Relationship of conservation, passive solar, and active solar strategies in design of small buildings. Exercises and case studies provide hands-on experience with systems, calculating techniques, evaluative methods as a basis for understanding space-heat requirements.

LANDSCAPE ARCHITECTURE (LA)
CONTACT Roger Martin, 205 North Hall, 376-7537

5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.
(4 cr, ~FR 5233; 4 lect hrs per wk)
For advanced students interested in design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development;

parks, collection, storage, treatment, and disposal. Utilization of liquid and solid wastes. Nonurban water supply and quality.

5105. RECREATIONAL PLANNING AND DESIGN.
(6 cr;prereq 5010; 2 lect and 12 lab hrs per wk)
Analysis, development, and presentation of landscape design solutions for diverse, recreational land uses.

5227. IMPACT ASSESSMENT AND ENVIRONMENTAL MEDIATION.
(5 cr;prereq Senior or grad or #)
Lectures on history, laws and analysis of impact assessment and environmental mediation. Interdisciplinary emphasis on fieldwork. Document preparation, presentation.

8350. SMALL COMMUNITY PLANNING AND THE CONSERVATION OF NATURAL RESOURCES.
(2 cr;prereq MLA student or #)
Examination of small community planning processes in rural America, their impact on natural resource use, and identification of opportunities for conserving resources in the small community development process.

8370. URBAN OPEN SPACE PRESERVATION AND REGENERATION.
(2 cr;prereq MLA student or #)
Search for effective methods of urban open space preservation; exploration of research methods, technical knowledge areas, and policies necessary for quality regeneration and renewal.

BIOLOGY (Biol)

College of Biological Sciences
223 Snyder Hall
CONTACT Kathleen Peterson, 223 Snyder Hall, 373-3648

1009. (formerly 1011) GENERAL BIOLOGY.
(5 cr;prereq ~1011)
Introduction to the principles of biology. The cell, metabolism, heredity, reproduction, ecology, and evolution. Includes laboratory.

1102f,w.MICROBES AND MAN.
(4 cr)
Mircoorganisms in relationship to humans and their environment in the processing and preservation of food, waste disposal, and environmental factors; bacterial products of industrial and pharmaceutical importance; role of microorganisms in recycling elements of the biosphere; microorganisms and disease.

1103f,w,s,su.GENERAL BOTANY.
(5 cr, ~3012;prereq 1009; students who plan to major in biology in CLA or in any bioscience major in CBS should take 3012)
Levels of organization of plants, plant function, plant growth and development, plant reproduction.

1106f,w,s,su.GENERAL ZOOLOGY.
(5 cr;prereq 1009)
Survey of animal phyla; structure, function behavior, adaptation, and evolutionary relationships.

30011f,w,s,wu.ANIMAL BIOLOGY.
(5 cr, ~1106;prereq 1009, Chem 1005)
Comparison of ways different phyla have solved similar physiological problems. Laboratory includes survey of major animal groups and physiological experiments.

3012f,w,s.PLANT BIOLOGY.
(5 cr, ~1106;prereq 1009, Chem 1005)
Plant diversity and evolution; structure and function of the plant cell and of the whole organism; growth and development of plants.

3042f,w,s.FIELD PROBLEMS IN ECOLOGY.
(2 cr;prereq 3041 or EBB 3004 or #)
Student research projects on selected ecological problems.

3051su.BIOLOGY AND THE FUTURE OF MAN.
(4 cr;S-N only)
Nontechnical discussion of biological factors affecting the quality of life, e.g., pollution, chemical and biological

warfare, population growth, food supply, resource sufficiency, value of wilderness, genetics and eugenics, public health, aging, behavior control, and biological aspects of ethics, morals, and societal organization.

5041. (formerly 3041) ECOLOGY.
(4 cr;prereq Math 1142 or 1211, Biol 1103, 1106 or 3011 or 3012)
Growth, structure, and evolution of populations. Pairwise biotic interactions between species, effect on diversity and structure of natural communities. Nutrient dynamics, function, productivity, and temporal stability of ecosystems.

5951. SOCIAL USES OF BIOLOGY.
(4 cr,S-N only;prereq 10 cr sciences)
Influence of biological science on the quality of human life: agriculture, medicine, occupational health, environmental science, and theories of human nature. Responsibilities and roles of biologists in policy formulation in the scientific and political world.

BOTANY (Bot)
College of Biological Sciences
220 Biological Sciences Center
CONTACT D.C. Pratt, 220 Biological Sciences, 373-2211

1009s. MINNESOTA PLANT LIFE.
(4 cr; suitable for nonmajors)
Identification of the more characteristic and conspicuous Minnesota plants, including many lower forms, with discussion of their basic distinctions, life cycles, habitat requirements, distribution, vegetation types, and ecological relations. Lectures, discussions, six field trips.

1012f. PLANTS USEFUL TO MAN.
(4 cr; for majors or nonmajors)
Roles that plants have played in human biological and cultural development. Lectures and demonstrations.

3201w. INTRODUCTORY TAXONOMY.
(4 cr;prereq Biol 1103 or 3012)
Taxonomy of ferns, gymnosperms, and flowering plants (representative material largely drawn from Minnesota spring flora). Families of plants and their relationships; floral structure and function; taxonomic terms; nomenclature; literature; methods of collection and identification. Two or three field trips.

5205s. FLORA OF MINNESOTA.
(4 cr;prereq 3201 or #)
Vascular plants of Minnesota; taxonomic and floristic relationships; geographical distribution and variation; collection and identification. Field trips.

5231s. INTRODUCTION TO THE ALGAE.
(5 cr;prereq 10 cr in botany or biology or #;offered 1984-85 and alt yrs)
Structure, reproduction, and life histories of major algal divisions.

COURSES OFFERED AT LAKE ITASCA FORESTRY AND BIOLOGICAL STATION

5801su.PLAINS AND BOREAL FLORA.
(5 cr;limited to 20 students;prereq course in taxonomy,^;offered annually)
Survey of the summer flowering plants and ferns of the state with particular reference to the local flora. Identification by technical keys; important plant families; field recognition of common species; habitat preferences; collecting methods; literature; taxonomic methods.

5805su.AQUATIC FLOWERING PLANTS.
(5 cr;limited to 20 students;prereq course in taxonomy,^)
The higher plants of aquatic and marsh habitats. Identification and collection; association of species; relations to the habitat; adaptive morphology and food value to wildlife.

5811su.FRESHWATER ALGAE.
(5 cr;limited to 20 students;prereq 10 cr botany,biology or zoology, ^; offered annualy)
The developmental morphology and taxonomy of freshwater algae, including the relationshop of algae to their environment. Identification of field collections by technical keys, collecting and analytical methods, and utilization of information for recognizing distribution patterns.

5815su.BRYOPHYTES.
(5 cr;limited to 20 students;prereq 10 cr biology or #, ^ ;offered when feasible)
Field and laboratory study of the mosses and liverworts of Minnesota.

5821su.LICHENS.
(5 cr;limited to 20 students;prereq 10 cr in botany or zoology or #, ^;offered 1984 and alt yrs)
Taxonomy, ecology, and floristics of lichens of northern Minnesota; identification, sampling methods, microchemistry as a taxonomic tool.

5825. BIOLOGY OF THE FERNS.
(5 cr;prereq ^;offered when feasible)
Field and laboratory study of the lower vascular plants (including ferns, horsetails, club mosses, and quillworts), their evolution, classification, morphology, and ecology. Emphasis on field exploration for rare taxa, including natural hybrid forms and life cycles.

BUSINESS, GOVERNMENT, AND SOCIETY (BGS)
School of Management
830 Management and Economics
CONTACT R.J. Holloway, 1268 Mgmt/Econ, 373-4407

3003. BUSINESS AND THE NATURAL ENVIRONMENT.
(4 cr;prereq jr or sr)
Business and its relationship to the natural environment. Ths use by industry of renewable and nonrenewable resources. Environmental deterioration caused by businesses to air, land, and water. Business solutions to environmental problems. May emphasize energy in some quarters.

8010. BUSINESS AND GOVERNMENT II: GOVERNMENT SOCIAL REGULATION OF BUSINESS.
(4 cr;prereq MBA 8055, grad mgmt IR student or # and Grad Sct Mgmt approval)
The public policy process as a regulator of business behavior. Regulation to achieve key social objectives - environmental protection, product and job safety, equal employment opportunity, ERISA and other regulation. Role of social responsibility and business ethics. Monitoring economic and social trends. Organizing for social responsiveness.

CHEMICAL ENGINEERING (ChEn)
Institute of Technology
151 Amundson
CONTACTS W. Ranz, 151N Amundson, 373-2296
A. Fredrickson, 431 Amundson, 373-2312

5751-5752-5753.BIOLOGICAL ENGINEERING ANALYSIS.
(3 cr per qtr;prereq #; 3 lect hrs per wk)
Modeling and analysis of biosystems. Thermodynamics, transport and transfer, biochemical reactions, growth and death processes from both deterministic and probabilistic viewpoints.

5801. AIR POLLUTION CONTROL ENGINEERING.
(4 cr; 4 lect hrs per wk)
Analysis and design of equipment used to reduce emission of gases and particulates. Methods for controlling air pollution.

CIVIL ENGINEERING (CE)
Institute of Technology
122 Civil and Mineral Engineering
CONTACT W. Maier, 148 Civil and Mineral Engineering, 373-2517

3500. INTRODUCTION TO ENVIRONMENTAL ENGINEERING PROBLEMS AND ANALYSIS.
(4 cr;prereq Chem 1005)
Environmental problems and an interdisciplinary approach to problem solving. Water pollution, water pollution control technology, air pollution, air pollution control technology, noise, alternative energy resources, solid waste disposal, nuclear energy, radioactive wastes and the overall impact of technology on environmental quality.

5212. TRANSPORTATION PRODUCTIVITY AND ENERGY CONSERVATION.
(4 cr;prereq #)
Measuring transportation productivity and energy consumption; application of control theory for improving transportation productivity; simulation of energy-conservation policies and effect of such policies on transportation ridership and economics through time; transportation use and energy consumption in relation to urban and rural structures; case studies.

5401. WATER RESOURCES ENGINEERING.
(4 cr;prereq IT or grad student, 3400 or #; 3 lect and 3 lab hrs per wk)
Introduction to water resources engineering including flow in conduits, pumps, open channels and culverts; introduction to flow measurements, hydraulic structures and systems approach to water resources engineering.

5405. HYDROLOGY AND HYDROLOGIC DESIGN.
(4 cr;prereq IT or grad student, 5401 or #; 3 lect and 3 lab hrs per wk)
Hydrologic cycle, precipitation, evaporation, infiltration, runoff analysis, flood routing, statistical procedures in hydrology, urban hydrology, introduction to mathematical models of medium and large watersheds, application of hydrology to design of outlet works and flow control structures.

5420. INTRODUCTION TO WATER RESOURCES MANAGEMENT.
(4 cr)
U.S. and world water resources; human water use; economic, environmental, social, and political problems related to water.

5425. GROUNDWATER MECHANICS.
(4 cr/prereq IT or grad student, 3400 or #)
Basic equations. Horizontal confined, unconfined, and interface flow. Flow from rivers and lakes toward wells. Systems of interconnected aquifers. Leaky flow. Modeling of aquifers through integral equation techniques. Nonsteady flow. Application of finite element methods. Explicity finite difference methods.

5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS.
(4 cr;prereq IT or grad student, 3400, 3500 or #)
Planning and engineering design considerations in developing waste disposal systems for urban centers. Volumes and quality of waste streams, treatment and ultimate disposal of domestic and industrial wastewaters, and storm water runoff. Environmental effects, cost, and political aspects of ultimate disposal.

5505. WATER QUALITY AND TREATMENT.
(4 cr; prereq IT or grad student, 3500 or #)
Chemical and physical properties of natural waters, introduction to aquatic biology, and ecological considerations of element cycling of natural carbon, nitrogen, phosphorus, oxygen, and anthropogenic chemical species (pesticides, PCBs, heavy metals). Physical and chemical processes of water treatment.

5506. ENVIRONMENTAL WATER CHEMISTRY.
(4 cr;prereq IT or grad student, Chem 1006 or #; 3 lect and 1 rec hrs per wk)
Composition of natural waters and wastewater; chemical processes affecting distribution of pollutants and waters; methods of evaluation to determine fate of organic pollutants.

5510. SOLID WASTE MANAGEMENT.
(4 cr)
Solid waste disposal for urban areas in terms of volume, composition, and chemical characteristics. Methods and equipment of collection and treatment. Various disposal methods in terms of their effects on the environment and unit costs.

5511. HAZARDOUS WASTE ENGINEERING.
(4 cr;prereq 5510 or #; 3 lect and 2 lab hrs per wk)
Analysis and design of facilities for disposal of hazardous wastes. Focuses on technologies for treatment and conversion of wastes into reusable or innocuous materials; technologies for isolation and permanent storage of hazardous residues.

5580. INTRODUCTION TO ENVIRONMENTAL LAW FOR ENGINEERS.
(3 cr; 3 lect hrs per wk)
Common statutory and regulatory law relevant to the work of civil and environmental engineers; history and development of environmental control with emphasis on public policies behind decision making in courts, legislatures, and administrative agencies and tribunals.

5581. ENVIRONMENTAL LAW.
(4 cr; prereq 5580)
Specific provisions of federal and Minnesota statutory and regulatory law such as NEPA, TOSCA, RCRA, the Clean Air Act, and the Minnesota Environmental Rights Act; history of these acts in court.

8406. SEMINAR: ADVANCED HYDROLOGY.
(1 cr)
Weekly seminar by staff, students, and guest speakers

8419. WATER RESOURCES SYSTEMS SIMULATION.
(4 cr prereq 5401 or #)
Computer simulation of water resource systems, including hydrology systems stream flow and quality systems, economic systems and sociopolitical systems using deterministic and stochastic approaches.

8425. ADVANCED GROUNDWATER MECHANICS.
(4 cr;prereq 5425 or #)
Conformal mapping techniques for two-dimensional steady groundwater flow. The hodograph method. Problems involving a free boundary and horizontal drains. Boundary value problems. Application of boundary integral equation techniques.

8430. LAKE AND RESERVOIR HYDRODYNAMICS.
(3 cr;prereq #)
Overview of hydrodynamic phenomena analysis of density stratification; energy and momentum transfer through a water surface; wind effects of stratification and circulation; standing or progressive waves stratified flow; density currents; selective withdrawl; mixing.

8510. INDUSTRIAL WASTEWATER TREATMENT AND DISPOSAL.
(3 cr;prereq #)
Quantity and quality characteristics of industrial wastewater. Problems with separate treatment and joint treatment with municipalities. Legal responsibilities and ordinances. Determination of equitable charges.

COMMUNICATION DISORDERS (CDis)
College of Liberal Arts
110 Shevlin Hall
CONTACT W.D. Ward, 2630 University Ave. S.E., 373-4565

5704. NOISE AND MAN.
(4 cr;prereq 5301 or #)
Temporary and permanent effects of steady, intermittent, and impulse noise on hearing and health. Annoyance and community noise. Noise measurement, reduction, and control; ear defenders and their limitations. Hearing conservation programs; preemployment testing and monitoring audiometry.

ECOLOGY AND BEHAVIORAL BIOLOGY (EBB)
College of Biological Sciences
109 Zoology
CONTACT Edward J. Cushing, 109 Zoology, 373-5177

3001. INTRODUCTION TO ECOLOGY.
(4 cr;open to jrs and above but not to biology majors)
Basic concepts in ecology; the organization, development, and functioning of ecosystems; population growth and regulation. Human impact on ecosystems.

3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS.
(4 cr,~3001;not open to biology majors;prereq Math 1231)
Description and analysis of the spatial and temporal interactions between populations in ecosystems; processes affecting populations; transformations of energy and materials in the biosphere. Lectures and recitations.

5014. ECOLOGY OF PLANT COMMUNITIES.
(5 cr;prereq 3004 or Biol 3041, 1 qtr statistics or #)
Methods of describing, sampling, and classifying plant communities; theory of their structure and development, and of the stability of the interactions among their constituent populations. Field trips to examine local vegetation types; analysis of quantitative data.

5016. ECOLOGICAL PLANT GEOGRAPHY.
(5 cr;prereq 3004 or Biol 3041, Bot 3201;offered 1984-85 and alt yrs)
Vegetation regions of the world and North America in detail; ecological principles of plant distribution; interpretation of regional and temporal patterns in the distribution of vegetation and taxonomic groups. Field trips to floristic regions of Minnesota.

5051. ANALYSIS OF POPULATIONS.
(4 cr,~8001;prereq 3004 or Biol 3041 or #)
Factors involved in the regulation, growth, and general dynamics of populations. Data needed to describe populations, population growth, population models, and regulatory mechanisms.

5052. THEORETICAL POPULATION ECOLOGY.
(4 cr;prereq Biol 3041 or #)
Theories of population ecology, including models of growth and regulation of single populations, and of interactions between populations, including competition, predation, mutualism; emphasizes assumptions and rationales of models and their predictions for dynamics, stability, diversity of communities.

5053. THEORY OF STRUCTURED POPULATIONS.
(4 cr,prereq Math 1231, Biol 5041 or equiv, EBB5052 or equiv)
Mathematical models of populations with genetic, age, size and/or spatial structure and influence on population dynamics. Genetic feedback. Optimal life histories.

5112. INVERTEBRATE BIOLOGY.
(5 cr;prereq Biol 1106 or 3011 or #;offered 1984-85 and alt yrs)
Morphology, physiology, behavior, ecology, and evolution of invertebrate groups. Laboratory study of living marine, freshwater, and terrestrial representatives.

5114w. VERTEBRATE BIOLOGY.
(4 cr;prereq Biol 1106 or 3011)
Vertebrates; their biology, taxonomy, and distribution.

5122. PLANT/ANIMAL INTERACTIONS.
(4 cr;prereq Biol 3011, 3012 or #)
Herbivority, pollination, seed dispersal. Implications of interaction for plants and animals at organismal, population, and community levels. Coevolution.

5129. MAMMALOGY.
(5 cr, ~FW 5129;prereq Biol 1106 or 3011 or #)
Recent families and orders of mammals of the world and of genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.

5132. HERPETOLOGY.
(5 cr;prereq Biol 1106 or 3011 or #;offered 1984-85 and alt yrs)
Distribution, classification, and evolution of amphibians and reptiles of the world. Physiological, morphological, and

behavioral aspects of adaptive trends. Laboratory and lecture.

5134. INTRODUCTION TO ORNITHOLOGY.
(5 cr;prereq Biol 1106 or 3011)
Laboratory and field course in structure, classification, distribution, migration, habits, habitats, and identification of birds. Weekend trips scheduled.

5136. ICHTHYOLOGY.
(4 cr;prereq 15 cr incl Biol 1106 or 3011)
Biology of fishes including development, systematics, anatomy, physiology, and ecology.

5601. LIMNOLOGY.
(4 cr,~Geo 5601;prereq Chem 1005 or #)
Description and analysis of the events in lakes, reservoirs, and ponds, beginning with their origins and progressing through their physics, chemistry, and biology. Interrelationships of these parameters and effects of civilization on lakes.

5603. PLANKTON POPULATIONS.
(5 cr;prereq 5601 or 5812, Biol 3041 or #;offered 1984-85 and alt yrs)
Biology of plankton and analysis of the maintenance and regulation of planktonic populations. Laboratory studies of the taxonomy, morphology, and biology of plankton. Two Saturday field trips.

5604. BIOLOGICAL LIMNOLOGY.
(3 cr;prereq 5601 or 5612 or #)
Survey of the taxonomy and natural history of planktonic and benthic organisms in lakes and streams, descriptions of planktonic and benthic populations, and analyses of processes that regulate population densities of aquatic organisms.

5605. LABORATORY IN BIOLOGICAL LIMNOLOGY.
(2 cr;prereq 5601 or 5812 or #)
The morphology and identification of planktonic and benthic organisms in lakes and streams, use of sampling equipment and instruments in the field, and analysis of field data.

5606. ECOLOGY OF FISHES.
(5 cr;prereq Biol 1009 or 1106 or equiv plus 10 cr in the biological sciences;offered 1984-85 and alt yrs)
Ecological requirements of fishes with emphasis on nongame species, habitat, food, interactions among species, and behavioral, anatomical, and physiological adaptations. Fishes in the aquatic ecosystem with emphasis on fresh waters.

5607. ECOLOGY OF ANIMAL PLANKTON.
(4 cr;prereq Biol 5041, EBB 5601 or #)
Biology of animal plankton, including distribution of zooplankton in lakes, ecosystem functions such as grazing and remineralization, determination of production, physiological responses to contaminated environments, and important aspects of behavior.

5608f. ECOSYSTEMS: FORM AND FUNCTION.
(3 cr;prereq 5601 or Biol 5041, Chem 1002 or 1005;offered 1983-84 and alt yrs)
Nature and development of terrestrial wetland and aquatic ecosystems. Analysis of energy flow and element cycling in relation to environmental controls, self-regulation, natural and human disturbances.

5611. LINMOLOGY LABORATORY.
(2 cr;prereq EBB 5601 or Geol 5601 or #)
Principal techniques for obtaining information about environmental conditions in lakes and streams. Procedures for measuring the abundance and population dynamics of aquatic organisms, with special emphasis on plankton, field instruments, sampling devices, chemical analyses, microscopy and analysis of data. One Saturday field trip.

5612. BIOGEOCHEMICAL CYCLES.
(3 cr;prereq Biol 3041, Biol 5001, or MicB5321 or #)
Biogeochemical cycles for essential, nonessential, and toxic elements in the biosphere. Emphasis on human impact on biogeochemical cycles and on the connections between these cycles.

5613. ASSESSING THE ECOLOGICAL EFFECTS OF POLLUTION.
(4 cr;prepre Biol 5041 or equiv, Chem 3301, 3302)
Assessment of effects upon species and ecosystems, methodological problems, initial phases of investigating a new pollutant, problems of prediction.

COURSES OFFERED AT LAKE ITASCA FORESTRY AND BIOLOGICAL STATION.

3800.suINTRODUCTION TO FIELD RESEARCH.
(10 cr;limited to 20 students;prereq 2 courses in biol,^;hrs ar)
An intensive course on how to do research. A series of ecological and behavioral projects provide an introduction to the biology of forests, prairies, lakes, and marshes of the Itasca region while serving to develop individual abilities in the planning and design of experiments, acquisition and analysis of data, and the preparation of field reports. Intended for undergraduates with little or no previous experience in field biology.

5812su.AQUATIC ECOLOGY.
(5cr;limited to 20 students;prereq 15 cr biology, 5 cr chemistry,^;offered annually)
General limnology of lakes with emphasis on the biology of lakes in the Itasca region as related to their physical and chemical stratification in summer. Team projects in field research.

5814su.COMMUNITY STRUCTURE AND FUNCTION.
(5 cr;limited to 20 students;prereq course in ecology,^;offered annually)
Communities represented in Itasca Park and vicinity, with emphasis on vegetation. Patterns of distribution of the communities, their interaction with the environment, and their dynamic relationships. Methods of community description and analysis.

5817s,su. VERTEBRATE ECOLOGY.
(5 cr;prereq course in ecology,#,^)
Field studies on populations and their relationships to local environments; habitat analysis and ecological research methods. Designed primarily for students with fisheries and wildlife management interests. (Lab charge required.)

5820su.WETLAND ECOLOGY.
(10 cr;limited to 15 students;prereq 15 cr biology,^;introductory chemistry, course in plant identification, Biol 3041 recommended)
Nature, origin, and development of lake, marsh, swamp, and bog ecosystems; environmental control and productivity.

5834s,su. FIELD ORNITHOLOGY.
(5 cr;prereq Biol 1106,^;offered annually)
Emphasis on the breeding season, biology, behavioral ecology of birds in the Itasca region. Field trips taken to a variety of habitats to learn bird identification and observe and practice techniques for conducting field studies. Laboratory sessions investigate family distinctions and species identification. Individual field projects. Designed primarily for students with fisheries and wildlife management interests. (Lab charge)

ECONOMICS (Econ)
College of Liberal Arts
1035 Business Administration
CONTACTS Edward Coen, 1035 Business Administration, 373-3690
Harlan Smith, 1149 Business Administration, 373-3572

5611. ECONOMICS OF ENVIRONMENTAL CONTROL.
(4 cr;prereq 1001, 1002 or equiv)
Pollution as an external diseconomy, use of taxes and subsidies to reduce pollution. Replenishable resources maximum sustainable yield, role of the discount rate, taxation to protect yields and minimize harvesting costs. Nonreplenishable resources, controlling rates of depletion.

EDUCATION, ELEMENTARY (Elem)
College of Education
CONTACTS Department Office, 125 Peik Hall, 373-3974

5348. WORKSHOP: OUTDOOR SCIENCE EDUCATION.
(3 cr;prereq elementary tchg exper)
Classroom and fieldwork activities dealing with models, materials, and methods in the outdoor setting; consideration of

broad topics such as ecological relationships, cyclic processes, and change as well as more specific topics such as rocks and minerals, plants and animals, and stargazing.

ENTOMOLOGY (Ent)
College of Agriculture
219 Hodson Hall
CONTACTS David W. Ragsdale, 416 Hodson Hall, 376-5014

1005. ECONOMIC ENTOMOLOGY.
(4 cr;prereq Biol 1009 or #)
Brief introduction to structure and classification of insects; management of insect populations; life histories, habits, and recognition of insect pests of livestock, orchards, field crops, vegetables, and ornamentals.

3175. INTRODUCTORY ENTOMOLOGY.
(5 cr;prereq Biol 1009 or equiv)
General morphology, life histories, habits, and classification of insects.

5020. FIELD ENTOMOLOGY.
(5 cr;prereq introductory biology;offered SSI at Itasca)
Insect fauna in various natural habitats of the park and surrounding areas. Includes field trips and collection and identification of insects, as well as studies of general morphology, life histories, and habitats of local species.

5050. FOREST ENTOMOLOGY.
(4 cr;prereq any two courses among the forestry, zoological, botanical, biological and/or agricultural sciences)
Lectures and laboratory concerning ecology and population management of forest insects, with heavy emphasis on tree factors and biological control.

5130. AQUATIC ENTOMOLOGY.
(5 cr;prereq 3175 or 5020 or equiv or #;offered at Itasca)
Identification and biology of aquatic and littoral insects in all stages.

5210. INTEGRATED PEST MANAGEMENT
(5 cr;prereq 1005 or #, {5211, {5212)
Management of insect, mite, and weed populations through integration of various methods and techniques (including biotic agents, host plant resistance, artificial measures, and cultural practices) as harmonious systems that, in the context of the associated environment and population dynamics, maintain subeconomic pest densities.

5213. BIOLOGICAL CONTROL ON INSECTS.
(2 cr;prereq 5210,introductory entomology and course in ecology)
Principles of biological control; history, ecological basis, classical biological control, augmentation, analysis of selected projects.

5250. PRINCIPLES OF ECONOMIC ENTOMOLOGY.
(4 cr;prereq 15 cr biological sciences and entomology incl 1005 or #;offered 1984-85 and alt yrs)
Methods and principles of insect control. Individual projects.

5400. EXPERIMENTAL ECOLOGY.
(3cr;prereq 9 cr biology or equiv, 3 cr animal or plant ecology or #)
Experimental approach to study of environmental factors affecting animal populations.

8300. EXPERIMENTAL ECOLOGY LABORATORY.
(2 cr;prereq 5400 or {5400)
Companion course of Ent 5400.

8305. INSECT ECOLOGY.
(3 cr;prereq 5400 or #)
Dispersal, distribution, abundance, natural control and related problems.

ENVIRONMENTAL HEALTH (PubH)
School of Public Health
1158 Mayo Memorial Building
CONTACT R.D. Singer, 1162 Mayo, 373-8080

3151. INTRODUCTION TO ENVIRONMENTAL HEALTH.
(3 cr)
Impact of environment on human health. Includes air pollution, water pollution, solid and hazardous waste, food sanitation, vector borne diseases, occupational health, safety, and radition protection. Spring quarter.

5151. ENVIRONMENTAL HEALTH.
(3 cr;prereq #)
Methods for promoting human health and comfort by controlling environment.

5152. ENVIRONMENTAL HEALTH.
(2 cr)
General principles of environmental health relating macro and micro environments and products consumed or used by people.

5156. ENVIRONMENTAL HEALTH I.
(2 cr;prereq environmental health student or #)
Biological, chemical and physical aspects of naturally and artificially produced environments. Mechanisms by which environmental components react and affect people.

5157. ENVIRONMENTAL HEALTH II.
(2 cr;prereq environmental health student or #)
Environmental health prevention and control strategies, measurements monitoring surveillance, close response relationships and remedial actions.

5171. ENVIRONMENTAL MICROBIOLOGY.
(3 cr;prereq MicB 3103 or #)
Survival, dissemination, transportation and significance of miccroorganisms in the environment; application of principles to environmental health problems.

5172. ENVIRONMENTAL MICROBIOLOGY LABORATORY.
(2 cr;prereq 5171, #)
Laboratory and field exercises in microbiological sampling, detection, enumeration, and control.

5177. PUBLIC HEALTH BIOLOGY.
(3 cr;prereq environmental health students only or #)
Introduction to plant and animal forms important in environmental health; biological aspects of water supply, waste treatment stream and special phenomena related to human disease transmission.

5181. AIR POLLUTION.
(3 cr;prereq general chemistry or #)
Overview of current air pollution problems; sources; chemistry of air pollutants and polluted atmospheres; potential human health effects; air pollution control technology; laws regulating air pollution.

5184. AIR ANALYSIS.
(3 cr/prereq 5211, #)
Laboratory and field exercises involving air flow calibration, dynamic calibration of field equipment for analysis of air contaminants, respirable mass sampling, dust counting and sizing, and instrumentation for measuring physical environmental stresses.

5194. OCCUPATIONAL SAFETY.
(2 cr)
Occupational safety procedures, environmental controls to reduce injuries on and off the job, safety program development and administration.

5201. RADIATION PROTECTION AND MEASUREMENT.
(2 cr,lect only, 3 cr lect and lab)
Ionizing radiation sources, detection and measurement protection principles, health implications.

5202. NUCLEAR POWER AND THE ENVIRONMENT.
(2-3 cr;prereq 5201 or #)
Sources, evaluation and control of environmental radioactivity, public health impact.

5211. INDUSTRIAL HYGIENE ENGINEERING.
(3 cr)
Concepts and techniques used in occupational health; evaluation of potential hazards, preventive techniques.

5212. VENTILATION CONTROL OF ENVIRONMENTAL HAZARDS.
(3 cr;prereq 5211, #)
Theory and application of exhaust ventilation in control of airborne environmental hazards; principles of exhaust hoods, air moving devices, gas cleaning devices; demonstration of measurement techniques; relationship of hazard and process to ventilation design criteria.

5214. AGRICULTURAL OCCUPATIONAL HEALTH.
(3 cr)
Occupational health problems of acrigultural workers; practical and available preventive measures; educational and administrative needs.

5215. APPLIED OCCUPATIONAL TOXICOLOGY.
(3 cr;prereq 5261 or #)
Basic toxicology and physiology with emphasis on environmental contaminants. Inhalation toxicology of the work environment and air pollution.

5231. ENVIRONMENTAL HEALTH AND SAFETY IN HEALTH CARE FACILITIES.
(4 cr;prereq #)
Environmental health concepts and problems related to isolation techniques; cleaning, disinfection, and sterilization; laundry processes; food service; critical care environments; interdepartmental relationships.

5233. BIOHAZARD CONTROL IN BIOMEDICAL LABORATORIES.
(2 cr;prereq #)
Topics include assessment of risk; primary barriers; laboratory design criteria; safety devices and equipment; personnel practices; sterilization and decontamination; laboratory animals; and shipping and disposal of biohazardous agents.

5241. ENVIRONMENTAL HEALTH ASPECTS OF WATER SUPPLY.
(3 cr)
Role of water in human health; physical, chemical, and biological characteristics; evaluation of source, treatment and distribution systems.

5242. ENVIRONMENTAL HEALTH ASPECTS OF GROUNDWATER SYSTEMS.
(2 cr)
Groundwater geology, quality, and treatment, well design, contruction and maintenance; special references to public and environmental health problems.

5243. WATER AND HEALTH.
(3 cr)
Occurrences, health effects, and treatment of physical, chemical and biological agents in transmission of waterborne diseases.

5244. ENVIRONMENTAL HEALTH ASPECTS OF WASTEWATER SYSTEMS.
(3 cr)
Role of liquid wastes in human health, physical, chemical, and biological characteristics; evaluation of source treatment and disposal facilities.

5253. INTRODUCTION TO HAZARDOUS WASTE MANAGEMENT.
(3 cr)
Review of roles of public and private sectors as generators, disposers and regulators of hazardous wastes. Includes definitions, sources, transportation, handling, treatment, recovery, disposal, and public health implications.

5261. GENERAL ENVIRONMENTAL TOXICOLOGY.
(3 cr)
Application of basic biochemical, anatomical and physiological principles to field of environmental toxicology; assessment of potential health hazards; approaches to solution of problems.

5265. APPLIED ENVIRONMENTAL TOXICOLOGY.
(3 cr;prereq 5261 or #)
Application of basic toxicologic principles to general environment; assessment of potential health hazards; approaches

to environmental problems; environmental regulationof toxic chemicals.

5267. ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY.
(3 cr)
Basic principles of toxicology (absorption, distribution, metabolism, excretion and site of action); issue specificity of chemical injury; risk assessment.

FISHERIES AND WILDLIFE (FW)
College of Forestry
200 Hodson Hall
CONTACTS L.D. Frenzel, 143 Hodson Hall, 373-1715 (wildlife)
J.A. Cooper, 104 Hodson Hall, 373-1722 (fisheries)

1002. WILFLIFE FOR NONMAJORS: ECOLOGY, VALUES AND HUMAN IMPACT.
(3 cr)
Controversial issues involving specific wildlife management principles and techniques. Designed for students without natural science background who are interested in natural resource topics, especially wildlife issues.

3052. INTRODUCTION TO FISHERIES AND WILDLIFE BIOLOGY AND MANAGEMENT.
(4 cr;prereq Biol 5041;3 lect, 1 demonstration-discussion per wk)
Introduction to fishery and wildlife population ecology; environmental relationships of fish and wildlife populations and habitats; management and research methods; fishery and wildlife agency administration.

3157. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.
(1 cr;offered at Cloquet)
Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.

5451. ECOLOGY OF FISH POPULATIONS.
(5 cr;prereq Biol 5041 or equiv, EBB/Geo 5601, EBB 5136, Stat 5022 or equiv or #)
Conceptual models of exploited fish populations; description of population characteristics; computer-assisted estimation of population parameters; influence of exploitation on population structure; yield models; relationships between parental stock, recruitment and yield; influence of abiotic factors on year-class formation.

5452. FISHERY MANAGEMENT IN INLAND WATERS.
(5 cr;prereq Biol 5041 or #)
Fundamental concepts and applications of fisheries management; pond and reservoir fisheries; lake and stream investigations, rehabilitation; lake fisheries management; warm-water and trout stream management. Field demonstrations on fish population surveys.

5455. AQUACULTURE.
(4 cr;prereq Biol 1009, 1103, 1106 or equiv, Chem 1001-2 or 1004-5 or equiv or #)
Role of aquaculture in resource management and world food production; principles of husbandry of aquatic organisms; interactions between fish metabolism and water quality; nutrition and energetics; pathology; genetics and selective breeding.

5456. FIELD ECOLOGY OF FISHES.
(5 cr;prereq introductory course in ecology; offered at Itasca)
Ecological studies, observation, and identification of fishes in their natural habitat including life histories, reproduction, behavior, good habits, interrelationships with other fishes, and general habitat requirements. Collection methods in streams and lakes.

5457. WATER QUALITY MANAGEMENT: FISHERIES.
(2 cr;5457-5458+, ~FR 5457;prereq Chem 1005 or equiv)
Determination of suitable water quality for fish including methodology, data analysis, and general responses to natural stresses and pollutants.

5458. WATER QUALITY MANAGEMENT: ECOSYSTEM APPROACHES.
(4 cr,~FR 5458;prereq Chem 1005, 3101 or #)
Anthropogenic influences on aquatic ecosystems. Influences include forest management, point and non-point pollution, and acid rain. Fishery impacts designed to supplement FR/FW 5457.

5561. WILDLIFE ECOLOGY, MANAGEMENT I: PLANNING POLICY AND ADMINISTRATION.
(4 cr;prereq 3052, sr fisheries or wildlife major or #)
Basic management concepts as related to wildlife resources. Establishment of goals, policies, and procedures. Strategic and operational planning. Development and evaluation of programs to achieve management goals. Application of simulation modeling and management science techniques in wildlife management.

5562. WILDLIFE ECOLOGY, MANAGEMENT II: POPULATIONS.
(4 cr;prereq 5561 or #)
Characteristics of wildlife populations relevant to management, including natality, recruitment, and mortality rates, density and behavior.

5563. WILDLIFE ECOLOGY, MANAGEMENT III: HABITATS.
(3 cr;prereq sr standing or #)
Habitat relationships of bird and mammal populations and the ecological basis for habitat management. Lectures, readings, library projects, and local field trips.

5564. WILDLIFE ECOLOGY, MANAGEMENT IV: FIELD PROBLEMS IN WILDLIFE RESOURCE MANAGEMENT.
(4 cr;prereq sr wildlife major or #)
Problem-solving exercises in the management of wildlife resources. Emphasis on development of management goals; collection, synthesis, and evaluation of data; and development of management recommendatins and/or plans. Lectures, readings, laboratory sessions, and local field trips; independent fieldwork usually required.

FOREST RESOURCES (FR)
College of Forestry
110 Green Hall
CONTACT Alan Ek, 204 Green Hall, 373-0843

1101. INTRODUCTION OT AIR AND WATER QUALITY.
(4 cr)
Air and water quality problems. Basic processes that govern the accretion, depletion, and cycles of specific types and sources of pollution. Methods of pollution abatement and influence of political, social, and economic pressures on the maintenance of a "quality environment."

1200. INTRODUCTION TO FOREST RESOURCES.
(3 cr)
Multiple forest resources and their management. history, policy, and current issues in forest resources. Lectures and laboratory (including field trips).

1201. CONSERVATION OF NATURAL RESOURCES.
(3 cr)
Development of thought on natural resource conservation in the United States. Renewable resources and their management problems; resource conservation and environmental management related to basic ecological principles.

1202. FARM AND SMALL WOODLANDS FORESTRY.
(3 cr for non-forestry majors, 2 cr for majors [3 cr with paper];prereq for majors 1100 or {1100)
Status and problems of the small woodland owner. Factors influencing tree growth. Cutting practices for and marketing products of small woodlands. Establishment and care of plantations, shelterbelts, and windbreaks. Field trips.

1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES.
(3 cr, ~1201; for non-forestry students)
Ecological, social, and economic implications of Minnesota's soil, water, forest, wildlife, and other resources are studied in field exercise and group discussions at nature centers and natural areas. Environmental teaching techniques for the elementary indoor classroom.

3100. IMPORTANT FOREST PLANTS.
(2 cr;prereq Biol 1103; given at Itasca)
Identification of forest plants as related to forest types.

3101. FIELD FOREST ECOLOGY.
(3 cr;prereq Chem 1001 or Chem 1004; given at Itasca)
Field examination of successsion, soils, silvical characteristics, tree classification, stand structure, and the ecology of regeneration.

3103. METEOROLOGY AND CLIMATOLOGY FOR RESOURCE MANAGERS.
(2 cr;prereq Phys 1001, Phys 1005 or #)
Fundamentals of meteorology and climatology as applied to wildland resource management.

3104. FOREST ECOLOGY.
(3 cr;prereq Itasca session)
Ecological concepts and principles as a basis for silvicultural practice. The forest as an ecosystem.

3220. BEGINNING FOREST SOILS.
(2 cr;prereq Itasca session, Geo 1001)
Basic soil properties and relationships to tree growth; soil development and classification.

3232. MANAGEMENT OF RECREATIONAL LANDS.
(3 cr;prereq #)
Recreational use of the forest and associated land and water. Policy problems arising form recreational demands.

5100. SILVICULTURE.
(3 cr;prereq Itasca session, 1100)
Introduction to silvics, forest regeneration and site preparation techniques, intermediate silvicultural practices, and silvicultural systems.

5101. FIELD SILVICULTURE I.
(4 cr;prereq 5100;given at Cloquet)
Regeneration surveys, plantation inspection, site preparation, and reforestation prescription. Practice in marking for thinning and determining effect on stands. Compartment examination and prescription. Written and oral reports.

5110. FOREST WATER QUALITY MANAGEMENT.
(4 cr;prereq 5114, Itasca session, or #)
Water quality in natural systems; concentrations in undisturbed systems, processes influencing temporal and spatial variation, design and interpretation of monitoring programs. Land uses that impact water quality in forested environments, including expected changes in concentration of various parameters, assessment techniques, legal ramifications, and management alternatives.

5114. FOREST HYDROLOGY.
(3 cr;prereq Itasca session, 3103, Geo 1001 or #)
Introduction to the hydrologic cycle and hydrologic processes. Effects of forest management activities on water yield, storm flow, and water quality.

5115. FOREST HYDROLOGY, FIELD APPLICATIONS.
(2 cr;prereq 5114 or #;given at Cloquet)
Use of hydrologic instrumentation to measure precipitation, streamflow, infiltration capacity, soil moisture, air temperature, evaporation, and selected water quality constituents. Collection and interpretation of hydrologic information to evaluate forest-use impacts on water quantity and quality.

5126. FIELD FOREST SOILS.
(2 cr;prereq 3220, 5114;given at Cloquet)
Field examination of forest soils and their relationship to site productivity and forest management.

5150. FOREST ECOLOGY SEMINAR.
(3 cr;prereq sr, 3101, 5100 or #)
Survey of classical concepts and contemporary developments in ecology as related to forestry. Discussion group format.

5153. ADVANCED FOREST HYDROLOGY.
(4 cr;prereq 3220, 5114 or #)
Current hydrologic problems in the management of forested watersheds. Analytical methods to evaluate effects of vegetation management on the quantity and quality of runoff. Lecture and laboratory.

5222. FOREST POLICY AND ECONOMICS.
(5 cr or cr ar, ~5265;prereq AgEc 1030 or #)
Forest resource supply and consumption relationships, United States and world; legal and political factors; basic economic analysis of forestry activities (production, consumption, and investments).

5231. RANGE MANAGEMENT.
(3 cr;prereq Biol 1103 or #)
Important range plants; range livestock; range management methods and improvements; public grazing land administration; relationship of livestock grazing to wildlife, forest, watershed, and recreation management on public and private range lands.

5233. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING.
(4 cr;prereq 5232 or #)
(Same as LA 5010) For advanced students associated with design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, summer and winter recreational facilities.

5236. FOREST RECREATION PLANNING.
(1 cr;prereq 5232;given at Cloquet)
Recreation area and site planning, examples and managerial concerns. Field work and presentation.

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.

5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR.
(3 cr;prereq 5232, RRM major or grad student or #)
Development of environmental framework for understanding recreation behavior. Contributions of several disciplines, current cultural trends, management implications.

5261. ADVANCED FOREST POLICY AND ECONOMICS.
(3 cr;prereq 5222 or #)
Advanced topics concerning the quantitative techniques for analyzing forestry policy and economic activities; economic analysis of forestry projects; analyses of political and legal processes in forestry; review of literature on forest policy and economics; case studies.

5262. REMOTE SENSING OF NATURAL RESOURCES.
(4 cr)
Introduction to remote sensing for natural resource inventories, land use analyses, and environemental monitoring activities; photographic, thermal, multispectral, and radar sensing procedures; ariborne and satellite systems; visual and computer-assisted analysis techniques; oriented toward an interdisciplinary audience.

5265. FOREST POLICY ISSUES.
(3 cr, ~5222)
Processes by which forestry issues evolve and are resolved; systematic analysis of issues (defining issues, assessing special interest group concerns, defining objectives and alternatives); analysis of selected forestry issues such as sustained yield, clear-cutting, forest practice regulation, multiple and dominant use, and energy conservation.

5406. FORESTRY WORKSHOP FOR TEACHERS.
(5 cr)
Forest ecosystems and forest management studied in lecture and laboratory sessions conducted in a forest environment. In field exercises, techniques and materials are developed for teaching principles of forestry in indoor and outdoor classrooms. Tours to forest and wildlife research and management units and utilization locations, and discussions of contemporary forestry issues by guest lecturers.

5408. FORESTRY IN THE URBAN ENVIRONMENT.
(3 cr;prereq student teacher, teacher or #)
Study of forest ecosystems and forest management in lecture and laboratory sessions. Field exercises emphasize techniques and

materials useful for teaching principles of forestry in indoor and outdoor classrooms; forest areas in the Twin Cities used for field exercises. Special uses and problems of the urban forest. Discussions and presentations by guest lecturers on contemporary forestry issues.

5457. WATER QUALITY MANAGEMENT: FISHERIES.
(2 cr;prereq Chem 1005 or equiv)
Determination of suitable water quality for fish including methodology, data analysis, and general responses to natural stresses and pollutants.

5458. WATER QUALITY MANAGEMENT: ECOSYSTEM APPROACHES.
(4 cr;prereq Chem 1005, 3103 or #)
Anthropogenic influences on aquatic ecosystems. Influences include forest management, point and non-point pollution, and acid rain. Fishery impacts designed to supplement those discussed in FR/FW 5457.

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

8103. RESEARCH PROBLEMS: FOREST HYDROLOGY.
(Cr ar)

8213. TOPICS IN WILDLIFE HYDROLOGY.
(3 cr;prereq 5114, CE 5405 or #;offered alt yrs)
Lecture and discussion of current literature on the water resources of wildlands (non-urban, non-agricultural lands).

GEOGRAPHY (Geog)
College of Liberal Arts
414 Social Sciences
CONTACT R. Skaggs, 568 Social Sciences, 373-5774

1401. PHYSICAL GEOGRAPHY.
(5 cr, ~NSci 1501)
Distribution patterms of climate, relief, vegetation, and soils, regional differences in problems of physical development.

1425. INTRODUCTION TO METEOROLOGY.
(4 cr, ~Soil 1262)
(Same as Soil 1262) Precalculus introduction to nature of the atmosphere and its behavior. Topics include atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns, meteorological instruments and observation; plotting and analysis of maps; forecasting.

3344. GEOGRAPHY AND LAND USE DECISIONS.
(4 cr)
Analysis of how decisions are made to use land in the U.S. and descriptions of some of the results of those decisions.

3345f. ENERGY AND MINERALS.
(4 cr)
Sources, production, circulation, and consumption of power, metals, and nonmetallic minerals. Problems of exhaustion, susbtitution, pollution, costs, trade, and policy. National and local case studies.

3351. FOOD PRODUCTION AND DISTRIBUTION.
(4 cr)
Environmental constraints on agriculture, agricultural decision making, farming systems, contemporary issues in the U.S., and international food production and distribution.

3355. ENVIRONMENTAL PROBLEMS.
(4 cr)
Environmental problems associated with human activities.

3361. ENVIRONMENTAL EVALUATION AND ADAPTATION.
(4 cr ~3344)
Philosophies and practices concerning land use including how different peoples evaluate and adapt to their natural surroundings.

3421. CLIMATOLOGY.
(4 cr;prereq 1401 or #)
World distribution of climatic elements; methods of arranging climatic data; climatic classifications and world distributions of climatic types; general circulation; climatic change and climatic fluctuations.

3431. INTRODUCTION TO PLANT AND ANIMAL GEOGRAPHY.
(4 cr;not open to biology majors)
World distribution of plants and animals; biological and ecological background; the geographical picture; the paleoecological record.

3441f. LANDFORM GEOGRAPHY.
(4 cr)
The role of landforms in the distribution of resources; processes of landform origin and change; map interpretation of landforms; complex environmental history of the Quaternary period and its contribution to a complicated pattern of landforms, with emphasis on North America.

3451. GEOGRAPHY OF SOILS.
(4 cr, ~Soil 5512)
Distributions of soil-forming processes and soil types; soil differences in small areas; soil constraints on human activities in different places; regional differences in soil problems and management techniques - farming, forestry, construction, agri-business, suburbanization, homesteading.

3551. INTRODUCTION TO REMOTE SENSING.
(5 cr;prereq 8 cr in geography or #)
Theory and applications of imaging remote sensors to environmental problems. Remote sensor images in geographic studies.

5344. HISTORICAL GEOGRAPHY OF RESOURCE USE IN THE UNITED STATES.
(4 cr;prereq 3101 or 3344 or grad)
Analysis of the development of the American landscape, especially Minnesota, through studying how resources are used.

5423w. ADVANCED CLIMATOLOGY.
(4 cr;prereq 3421 or #)
Selected topics including energy balances, synoptic climatology, climate models.

5424. APPLIED CLIMATOLOGY.
(3 cr, ~Soils 5424;prereq Geog 3421 or Soils 5420 or #)
Application of climatic principles and data to selected problems in environmental management and agricluture.

5444. GEOGRAPHY OF WATER RESOURCES.
(4 cr;prereq two courses in physical geography or #)
Distributional aspects of the magnitude, quality, and dynamics of water resources. Aesthetic, recreational, and material production uses of water; consequences of human actions in the hydrosphere, expecially in fresh water.

8340. SEMINAR: LAND USE PLANNING.
(1-3 cr;prereq #)

8344. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.
(1 cr;prereq #)

8345. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.
(3 cr;prereq 8344)

8420. SEMINAR: CLIMATOLOGY.
(1-3 cr;prereq #)
Detailed study of selected topics. Topics vary from year to year; examples include modeling, climatic variability, predictability, severe local storms, drought, and energy balance.

GEOLOGY AND GEOPHYSICS (Geo)
Institute of Technology
108 Pillsbury Hall
CONTACT H.O. Pfannkuch, 2d Pillsbury Hall, 373-5678

1001f,w,s. PHYSICAL GEOLOGY.
(5 cr; 4 lect hrs and one 2-hr lab per wk)
Introduction to scientific method and nature of the earth; main features of the physical world and processes that have formed them.

1005w. GEOLOGIC PERSPECTIVES ON ENERGY.
(4 cr; 4 lect hrs per wk)
Introduction to the geologic aspects of energy resources, conventional and unconventional. History of energy use, distribution and amounts of known and potential reserves, environmental aspects and implications of U.S. consumption patterns.

1007s. ENVIRONMENTAL GEOLOGY.
(4 cr;prereq 1001)
Geological application in resource management, land use planning, technology, and conservation. Geological evolution of the biosphere and the impact of human activities on land, sea, and air resources. Geological hazards. The Twin Cities metropolitan area as a geological environment. Lectures, labs,and field trips.

1111s. INTRODUCTORY PHYSICAL GEOLOGY.
(5 cr;prereq high school or college chemistry or #;3 lect hrs, 1 rec hr, and two 2-hr labs per wk)
For prospecitve majors and others desiring a more intensive lecture and laboratory sequence than 1001.

1601 OCEANOGRAPHY.
(4 cr; 3 lect and 1 lab hrs per wk)
How various processes in the ocean interact; analogies between the oceans and Lake Superior and smaller lakes in Minnesota. Topics include marine biology, waves, tides, chemical oceanography, marine geology and human interaction with the sea. Lab work includes study of live marine invertebrates and manipulation of oceanographic data.

5002. STRUCTURAL GEOLOGY.
(4 cr, ~3103 or equiv;not open to geology, geophysics, geo-engineering, mineral engineering majors;prereq 3401 or 5004 or #;3 lect and 2 lab hrs per wk)
Primary and secondary structures of rocks, mechanics and modes of deformation, and structural techniques. Laboratory exercises in three-dimensional representation and solution of selected structural problems.

5004. MINERALOGY.
(4 cr, ~3401;not open to geology, geophysics, and geological or mineral engineering majors;prereq 1001 or #, 1 term college chemistry, Math 1221;3 lect hrs and 6 lab hrs per wk)
Crystallography, crystal chemistry, and crystal physics. Physical and chemical properties, crystal structures, and chemical equilibria of the major mineral groups. Laboratory includes crystallographic, polarizing microscope, X-ray powder diffraction exercises, and hand specimen mineral identification.

5108w. ADVANCED ENVIRONMENTAL GEOLOGY.
(4 cr;prereq geol core courses 1111 through 3103 or equiv or #)
Human impact on the geological environment and the effect of geology/geologic processes on human life from the point of view of ecosystems and biogeochemical cycles. Geologic limits to resources and carrying capacity of the earth. Land use planning, environmental impact assessment, ecogeologic world models. Field project.

5251s. GEOMORPHOLOGY.
(4 cr [5 cr with term project];prereq 1001, Math 1111 or #;3 lect,2 lab hrs per wk..lab often used for field trips)
The origin, development, and continuing evolution of landforms in various environments. Environmental implications are emphasized. Weathering, slope and shore processes, fluvial erosion and deposition, wind action, tectonics, and impact phenomena.

5601f. LIMNOLOGY.
(4 cr, ~EBB 5601;prereq Chem 1005 or equiv)
Events occurring in lakes, reservoirs, and ponds, their origins, physics, chemistry, and biology. Interrelationships of these parameters and effects of civilization on lakes.

5602f. CASE STUDIES IN LIMNOLOGY.
(3 cr;prereq 5601 or EBB 5601 and #)
Detailed analysis of specific studies on lakes, and problems of lakes throughout the world.

5603w. GEOLOGICAL LIMNOLOGY.
(4 cr;prereq 5601 or EBB 5601)
Tectonic and climatic setting of lakes; physical, chemical, and biological processes of sedimentation in lakes.

5611s. GROUNDWATER GEOLOGY.
(4 cr;prereq 1001 or 1111, Math 1231, 1 qtr physics and chemistry or #)
Origin, occurrence, and movement of groundwater viewed in the context of the hydrologic cycle. Characteristics of aquifer systems. Exploratory investigations. Hydrogeologic units and boundaries of regional systems. Analysis of surface water groundwater interaction, recharge. Quality and chemistry of groundwater supplies.

8602. ADVANCED LIMNOLOGY.
(3 cr;prereq 5601 or equiv, #;offered 1985-86 and alt yrs)
Detailed study of selected problems in limnology using current and classical literature. Term paper required.

8603. METHODS FOR ANALYSIS OF NATURAL WATERS.
(2 cr;prereq 5601 or equiv, #)
Analysis of ecologically important constituents and parameters of surface and groundwaters through different approaches. Term paper.

8612. ANALYTICAL GEOHYDROLOGY.
(3 cr; [4 cr with term paper];prereq Math 3221, CE 3400 or #)
Microphysics of flow through porous media; geological factors in aquifer performance; equations for groundwater flow; analysis of pumping tests; potential theory in groundwater flow; computer and analog models of aquifers; groundwater basin analysis.

8621. TRACERS IN HYDROGEOLOGY.
(2 cr;prereq #)
Use of tracers in hydrogeology to determine source, age, and mixing parameters of water in various natural reservoirs.

HISTORY (Hist)
College of Liberal Arts
CONTACT David W. Noble, 723 Social Sciences Bldg, 373-2696

3828. AMERICAN ATTITUDES TOWARD ENERGY AND ECOLOGY, 1945-PRESENT.
Major debates about energy and ecology since 1945 and relation of those debates to the history of American attitudes toward nature.

HISTORY OF SCIENCE AND TECHNOLOGY (HSci)
Institute of Technology
CONTACT Edwin T. Layton, 138 Mechanical Engineering, 373-3031

5311. TECHNOLOGY IN AMERICAN LIFE AND THOUGHT.
(4 cr)
Technology in America with emphasis on its impact on society and culture. Traces the growth of American technology in its cultural and intellectual context from colonial period to present.

HUMANITIES (Hum)
College of Liberal Arts
314 Ford Hall
CONTACT Richard Leppert, 310 Ford Hall, 373-3516

3625. SCIENCE AND THE HUMANITIES.
(4 cr;prereq jr or sr or #)
Implications for ethics and social design of competing claims made by the sciences and the humanities. Kinds of creativity and methodology of the two fields. Snow, Bronowski, Frye, Bohr, Beckett, Heisenberg, Skinner, E.O. Wilson.

3663. IDEAS OF NATURE: ENGLAND AND AMERICA TO 1875.
(4 cr;prereq jr or sr or #)
Nature in Anglo-American culture. Seventeenth-century ordered universal hierarchy and Puritan "garden in the wilderness," aesthetics of the sublime and picturesque, 19th-century romanticism and transcendentalism. Shaftesbury, Wordsworth, Thoreau, Hawthorne, Muir; clerics, philosophers, aestheticians, painters, poets, novelists, explorers.

INTERDEPARTMENTAL STUDY (ID)
College of Liberal Arts
203 Johnston Hall
CONTACT Mary Lymer, 203 Johnston Hall, 373-2446

3970. DIRECTED STUDIES.
(3-15 cr per qtr;prereq OSLO approval, ^)
Individual readings and research on topics that cross departmental lines.

5402. ECOLOGY, TECHNOLOGY, AND SOCIETY.
(4 cr per qtr)
5402: Growth of technological systems and their impact on society, values, and nature. Features of problems in transition to a sustainable society. Energy alternatives. Emerging life-support technologies and associated values.

JOURNALISM AND MASS COMMUNICATION (Jour)
College of Liberal Arts
111 Murphy Hall
CONTACT P. Tichenor, 35 Murphy Hall, 376-7104

5133. INTERPRETIVE REPORTING ABOUT SCIENCE.
(4 cr;prereq 3121 or #, ^)
Role of journalistic communication in science; scientist-journalist relationships; communicating results of scientific investigations to public, specialized audiences, industry.

5143. INTERPRETATION OF SCIENCE AND TECHNOLOGY.
(4 cr;prereq professional journalism major status, 5133 or #, ^)
Analysis of scientific research and technological development for mass and specialized media; critical study of science content in media; audience impact.

LAW SCHOOL (Law)
285 Law Building
CONTACT Robert F. Grabb, 290 Law, 373-2717

5201. LAND USE PLANNING.
(3 cr)
Public control of land use and development, and eminent domain.

5215. ENVIRONMENTAL REGULATION.
(3 cr)
Legal aspects of major environmental problems with emphasis upon pervasive issues that reappear in various regulatory contexts: e.g., the degree to which environmental quality should be protected; who should bear the cost of enhancing environmental quality; the allocation of responsibilities among courts, legislatures, and administrative agencies; the role of citizens' groups and environmental litigation.

MECHANICAL ENGINEERING (ME)
Institute of Technology
125 Mechanical Engineering
CONTACT B.Y. Liu, 130 Mechanical Engineering, 373-3043

5402. ECOLOGY, TECHNOLOGY, AND SOCIETY.
(4 cr, ~SSci 3402;prereq IT student of grad; 4 lect hrs per wk)
Dilemmas produced as a result of conflicts between finite limits and population and industrial growth; underlying causes; current technology, values, economics, institutions, and political structures; and possible directions for resolution. Faculty members from various disciplines participate.

5603. THERMAL ENVIRONMENTAL ENGINEERING.
(4 cr;prereq IT student or grad,3303,5342 or equiv;4 lect hr/wk)
Thermodynamic properties of moist air; h-W diagram for moist air; solar radiation; heat and water vapor transmission in structures; effects of thermal environments upon people, processes, and materials; thermal loads, thermal environmental control systems.

5607. INDUSTRIAL VENTILATION AND CONTAMINANT CONTROL.
(4 cr;prereq IT student or grad, 3303 and CE 3400 or equiv; 4 lect hrs per wk)
Contaminants, dispersion mechanisms, transport, fans, hoods, gas cleaners, behavior of jets and sinks, closed and open systems, applications to industrial processing and emission control.

5609. AIR POLLUTION.
(4 cr;prereq IT student or grad, 3303 or #; 4 lect hrs per wk)
Air pollution sources, atmospheric transport, transformations and fate. Air pollution meteorology, dispersion, and models. Basic chemistry of secondary pollutant formation, aerosol growth, air pollutant visibility relationships. Standards and regulations.

5612. ENVIRONMENTAL ENGINEERING.
(4 cr;prereq IT student of grad, 3303; 4 lect hrs per wk)
Basic principles of engineering assessment and control of emissions to air and water, noise measurement and control, and control, handling, and disposal of solid waste.

5615. AIR CONTAMINANT MEASUREMENT.
(4 cr;prereq IT student or grad, 5613 or #)
Principles of operation, application and interpretation of data from instruments and instrument systems used for inplant contaminants, emissions and air quality measurement.

5712. SOLAR ENERGY UTILIZATION.
(4 cr;prereq IT student or grad, 5342 or #; 4 lect hrs per wk)
History and potential of solar energy utilization; availability of solar radiation on clear and cloudy days; incident radiation on horizontal, vertical, and inclined surfaces; flat-plate and concentrating solar collectors; heating and cooling with solar energy; power generation; review of current research.

5721. PROPULSIVE SYSTEMS FOR SURFACE TRANSPORTATION.
(4 cr;prereq IT student or grad, 3301 recommended; 4 lect hrs per wk)
Characteristics of electrical and mechanical propulsion devices and energy storage systems available for use in various types of surface trasnport vehicles, worldwide energy sources, environmental implications of transport propulsive devices, power requirements, and thermodynamic constraints.

INDUSTRIAL ENGINEERING/OPERATIONS RESEARCH (IEOR)
CONTACT B.Y. Liu, 130 Mechanical Engineering, 373-3043

5701. TECHNOLOGY ASSESSMENT.
(4 cr;prereq upper dividion; 4 lect hrs per wk)
Unintended consequences of specific technologies on society. The history, institutional structures, and methodology of technology assessment; specific technology assessments. One or more class projects.

5710. TRANSPORT SYSTEMS ANALYSIS AND DESIGN.
(4 cr;prereq IT sr engineering status or grad; 3 lect and 1 rec hrs per wk)
Introduction to transit systems; performance and energy relationships; kinematical design of curved guideways; lateral

suspension dynamics; performance and cost effectiveness of shuttle, loop, line haul, and network systems operating in scheduled and demand modes; patronage analysis.

5711. TRANSPORT SYSTEMS ANALYSIS AND SESIGN.
(4 cr;prereq IT sr engineering status or grad, 5710,3 lect and 1 rec hrs per wk)
Design of transit vehicles for safe operation; reliability allocation in transit systems for minimum life cycle cost; theory of control of automated guideway transit systems; cost-effective design of guideway structures; synthesis and basic design requirements of transit systems for maximum cost and energy effectiveness.

MICROBIOLOGY (MicB)
College of Biological Sciences, College of Liberal Arts, and Medical School
1460 Mayo Memorial Building, 373-8070
CONTACT Palmer Rogers, 1015 Mayo Memorial Building, 373-8121

1101. ELEMENTARY MICROBIOLOGY.
(4 cr;prereq Biol 1009 or {Biol 1009 or equiv;intended for students in CLA, dental hygiene, physical therapy, mortuary science, others with #;not intended for majors)
Principles of microbiology; a general survey of pathogenic bacteria, molds, protozoa, and viruses; elements of immunity, sanitary analysis of water and milk, disinfectants and sterilants.

3103w. GENERAL MICROBIOLOGY.
(5 cr, ~5105, ~Biol 5013, ~VPB 3103;prereq soph with C avg in courses prereq to major sequence, or jr with 10 cr chemistry and 5 cr biological sciences or #)
Morphology, physiology, taxonomy, and ecology of bacteria. Applications of fundamental principles. Lab

5611f. MICROBIAL ECOLOGY.
(4 cr;prereq general microbiology course, Biol 5001 or #)
Microbial adaptation and diversity; role of microorganisms in natural processes; methods in microbial ecology; other topics of interest to microbial ecologists.

MINERAL ENGINEERING (MinE)
Institute of Technology
112 Mines and Metallurgy
CONTACT N.F. Schulz, Mineral Resources Research Cenrer, 373-3341

5710. ENVIRONMENTAL ASPECTS OF MINERAL ENGINEERING.
(4 cr;prereq 3rd yr IT or #; 4 lect hrs per wk)
Recognizing and minimizing the environmental problems posed by mining and metallurgical operations in both the immediate working environment and the larger ecological environment. Only a limited number of students from outside the department can be accommodated.

PHYSICS (Phys)
Institute of Technology
148 Physics
CONTACTS George Freier, 238 Physics, 373-3347
Homer Mantis, 359 Physics, 373-5474
Konrad Mauersberger, 42A Physics, 373-5458

1071. INTRODUCTORY METEOROLOGY.
(4 cr;prereq high school algebra; 4 lect hrs per wk)
Physics of atmospheric processes. Clouds, fronts, and cyclones. Weather forecasting. Human influence on the atmosphere.

1075. INTRODUCTORY METEOROLOGY LABORATORY.
(1 cr; S-N only;prereq 1071 or {1071;2 lab hrs per wk)
Field experiments offered in conjunction with 1071.

5441. INTRODUCTORY DYNAMIC METEORLOGY I.
(5 cr;prereq 1291 and Math 3231 or 5602 or #;3 lect and 3 lab hrs per wk)
Fluid dynamics of large-scale weather systems; mathematical introduction to quasi-geostrophic model used in numerical weather prediction. Concurrent laboratory study of weather charts to illustrate application of theory offered.

5442. INTRODUCTORY DYNAMIC METEOROLOGY II.
(4 cr;prereq 5441 or #)
Energetics and general circulation of the atmosphere.

5451. CLOUD PHYSICS.
(3 cr;prereq Math 3211 or equiv,1 yr general phys;3 lect hrs/wk)
Composition of the atmosphere, past, present, and future. Thermodynamics of atmosphere with condensable water. Properties and growth of drops and ice crystals. Particles in the atmosphere.

5452. CLOUD SYSTEMS.
(3 cr;prereq Math 3211 or equiv,1 yr general phys;3 lect hrs/wk)
Circulation, energy balance of atmosphere. Radar techniques for analyzing cloud systems. Cloud structure and motion.

5453. ELECTRICAL PROPERTIES OF CLOUDS.
(3 cr;prereq Math 3211 or equiv,1 yr general phys;3 lect hrs/wk)
Structural, thermodynamic, and electrical properties of water and ice. Ions in the atmosphere. Generation of charge and its effects on cloud processes. Generation of lightning and properties of lightning discharges.

5461. PHYSICS AND CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE.
(4 cr;prereq general physics and calculus)
Survey of atmosphere above 15 km; physics and chemistry of the stratosphere, mesosphere, and thermosphere; temperature and density profiles; major and minor constituents and their distributions; aspects of pollutants; reactions and rates; global variation of constituents; the energy budget of the atmosphere.

PLANT PATHOLOGY (PlPa)
College of Agriculture
304 Stakman Hall of Plant Pathology
CONTACT John V. Bell, 10 Green Hall, 373-0842

1001f,w. INTRODUCTORY PLANT PATHOLOGY.
(6 cr, 5050;prereq soph, 9 cr plant science)
Introductory course in plant diseases. Lectures and laboratory.

5002f,w. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS.
(6 cr, 1001, 505, prereq 14 cr plant sciences or #)
Introductory course in plant diseases. Lectures, laboratory and special problems.

5007s. NEMATODES AND ABIOTIC AGENTS IN PLANT DISEASE.
(4 cr;prereq 20 credit hours in biology, including biochemistry and plant physiology;offered spring quarter, yearly)
Nematodes and abiotic agents as plant pathogens with special emphasis on diagnosis, identification and methodology of control.

5050s. FOREST PATHOLOGY.
(4 cr, 1001;prereq Biol 1103 or equiv)
Diseases of forest and shade trees; wood decay. Sumptoms, etiology and control. Lectures, laboratory, and field work.

8003s. PLANT DISEASE THEORY III, POPULATIONS.
(4 cr;prereq PlPa 5005, 5006, 5007 or #, and 8001, 8002;spring quarter yearly)
Plant disease in populations of plants; agroecosystems, natural ecosystems, and interrelatedness of plant disease over large geographic areas. This course introduces elements of population genetics, epidemiology, and geopathology.

POLITICAL SCIENCE (Pol)
College of Liberal Arts
1414 Social Sciences
CONTACT Undergraduate Advising Office, 1482 Social Sciences, 373-2651

5623. THE POLITICS OF THE REGULATORY PROCESS.
(4 cr,prereq 1001 or equiv or #)
Operations of regulatory agencies considered in context of political and legal environment. Principles of federal administrative law, informal procedures, interest group activity, philosophy of regulation, politics and processes of deregulation.

PUBLIC AFFAIRS (PA)
(Hubert H. Humphrey Institute)
College of Liberal Arts
909 Social Sciences
CONTACT D.E. Abrahamson, 909 Social Sciences, 373-7756

5601. LAND USE.
(3 cr)
Physical, spatial basis for community and regional development. Private sector development processes. Public regulatory frameworks, guidance and interventional strategies. Integration of physical, social and economic factors in land use policy, planning and decision-making.

5622. DEVELOPMENT MANAGEMENT SYSTEMS.
(3 cr)
Integrated systems of controls and incentives to manage land development at state, metropolitan, and local government levels. Traditional planning and land use devices, tax and fee techniques, environmental regulations and innovative controls.

5701, 5702. TECHNOLOGY PLANNING I AND II.
(3 cr each)
Relationship of science and technology to ideological bases of our soceity; identification of technology's significance to the policy process; analysis of our society's intsitutions for governing its technologies.

5711. ENERGY POLICY I.
(3 cr)
Possible energy supply systems and ways energy is consumed; relatively non-technical description of physical systems, environmental and social impacts, regulatory frameworks, resource base, and relationship to energy policy options.

5712. ENERGY POLICY II.
(3 cr)
Energy policy options including political, economic, environmental, and other considerations.

5721. ENVIRONMENTAL POLICY.
(3 cr)
Systems in the natural and physical environment. Environmental impacts of technological innovation. Associated social controversy. Legislative, judicial, regulatory responses.

8600. SEMINAR: LAND USE PLANNING.
(3 cr)
Topics vary, similar to an advanced topics course.

8601-09. WORKSHOP/SEMINAR: ADVANCED TOPICS IN LAND USE AND HUMAN SETTLEMENTS.
(3 cr)
Advanced analysis of selected topics in land use and human settlements such as large scale planned communities, agricultural preservation, historical preservation, infrastructure planning and programming, urban transportation policy.

8701-09. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY.
(3 cr)
Topics in technology, energy, and environment, such as hazardous waste, energy efficiency, nuclear technologies, or atmospheric carbon dioxide.

RECREATION, PARK, AND LEISURE STUDIES (Rec)
College of Education
203 Cooke Hall
CONTACT Leo H. McAvoy, 209 Cooke Hall, 373-4232

5160. CONSERVATION OF PARK RESOURCES.
(3 cr;prereq 1520 or 5100 or ^)
Environmental considerations in relation to recreation and leisure services.

5250. FINANCING LEISURE SERVICES.
(3 cr;prereq 3550 or ^)
Methods and techniques of financing operations and capital improvements in public park and recreation agencies and nonpublic community leisure services; sources of revenue budgeting procedures.

5300. FOUNDATIONS OF OUTDOOR EDUCATION.
(3 cr;prereq sr, 1520 or 5100 or #)
Investigation of the philosophical, historical, and educational foundations of outdoor education.

5310. PROGRAMMING IN OUTDOOR EDUCATION.
(4 cr;prereq 5300 or #)
Methods, materials and settings for outdoor education and environmental interpretation programs.

5350. WILDERNESS OUTDOOR RECREATION PROGRAMMING.
(4 cr;prereq 3150, fitness test of running 2 miles in under 17 minutes, or #)
Exploration of leisure and educational resources of wilderness and management of wilderness-based outdoor recreation and outdoor education programs.

5900. WORKSHOP: CONTEMPORARY ISSUES IN LEISURE SERVICES.
(1-12 cr [max 12 cr];prereq ^)
Contemporary issues emphasizing administrative and supervisory functions for recreation and allied professionals; individual offerings focus on special issues and/or professional groups.

RESOURCE AND COMMUNITY DEVELOPMENT (RCD)
College of Agriculture
Room 130, Classroom Office Building
CONTACT Gordon D. Rose

1010. ISSUES IN THE ENVIRONMENT.
(3 cr)
Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 20 taped lectures and 10 discussion periods.

3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY.
(1 cr, ~Soil 3118; S-N only; offered fall 1984 and alt yrs)
Public policies as they influence land use and soil and water resources.

5099. RCD INTERDISCIPLINARY SEMINAR I.
(4 cr, 5099-5100+, ~RCD 5099, ~AgEc 5099, ~AgET 5099, ~Soil 5099;prereq resource and community development sr or #)
Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Students participate as a team, combining disciplinary skills to analyze complex resource development problems.

5100. RCD INTERDISCIPLINARY SEMINAR II.
(4 cr, 5099-5100+, ~RCD 5100, ~AgEc 5100, ~AgEt 5100, ~Soil 5100;prereq 5099 or #)
(Continuation of 5099) Papers, presentations, and critiques on selected complex resource problems in Seminar I.

5120. ENVIRONMENTAL PROBLEMS.
(3 cr, ~1010)
Interdisciplinary offering exploring five areas of environmental

concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes form agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 22 taped lectures and 10 discussion periods. Report on a specific environmental problem also required. Offered in Extension only.

5200. COMMUNITY DEVELOPMENT SIMULATION.
(4 cr for undergrad, 3 cr for grad; prereq #)
Participation in a water and land resource use and a fiscal management simulation of a community development process. Use of gaming simulation techniques in devising, testing, and negotiating alternative strategies of environmental and economic regulation and in assessing their private and social costs.

RHETORIC (Rhet)
College of Agriculture
202 Haecker Hall
CONTACT Department Office, 202 Haecker Hall, 373-0917

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 fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of America.

5700. COMMUNICATION IN TECHNOLOGICAL AND ENVIRONMENTAL IMPACT ASSESSMENT.
(4 cr;prereq sr or grad standing, one course in statistics, #)
Theories and processes involved in technological assessment and environmental impact statement preparation. Case studies of technology assessments, forecasts, and environmental impact statements. Term project on planning of process and project management in an actual impact assessment.

SOCIOLOGY (Soc)
College of Liberal Arts
1114 Social Sciences
CONTACT Robert Kennedy, 1125 Social Sciences, 373-2610

3551f,w. WORLD POPULATION PROBLEMS.
(4 cr)
Population growth and natural resources, population dynamics, fertility and mortality in less developed and industrialized nations, population forecasts, policies to reduce fertility.

SOIL SCIENCE (Soil)
College of Agriculture
108 Soil Science
CONTACT Russell S. Adams, Jr., Soil Science, 373-1361

1122. INTRODUCTORY SOIL SCIENCE.
(4 cr;prereq Chem 1001 or 1004)
Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures and laboratory.

1262. INTRODUCTION TO METEOROLOGY.
(4 cr)
(Same as Geog 1425) Pre-calculus introduction to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

3118. SEMINAR: SOIL POLLUTION AND PUBLIC POLICY.
(1 cr; S-N only; offered fall 1986 and alt yrs)
Round table discussions of assigned readings in the subject matter.

3220. SOIL, WATER MANAGEMENT, AND CONSERVATION.
(3 cr; prereq 3210 or #)
Factors affecting soil and water losses. Effect of soil tillage methods and cropping systems on structure maintenance, erosion control, water storage, and infiltration. Techniques and organizations in soil and water conservation.

3610. SOIL BIOLOGY.
(4 cr;prereq 1122 and PlPa 1001 or #)
The soil environment and its biological population. Role of living organisms in the soil-plant environment and cyclic transformations of agronomic interest (carbon, nitrogen, and mineral substances). Effect of soil microflora on soil fertility and plant nutrition. Lectures and laboratory.

5104. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING.
(4 cr, ~PlPa 5104, ~AgEc 5104, ~AnSc 5104; prereq Math 1142 or #)
Introduction to bioeconomic modeling as preparation for interdisciplinary agricultural systems analysis. Basic concepts; deterministric and stochastic models; delays, feedback, and clockwork; data aquisition; model verification and validation; role of models for agroecosystem management.

5240. MICROCLIMATOLOGY (SOILS).
(5 cr;prereq Math 1111, 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 by human activities including agricultural practices, description of the meteorological instruments, and use of weather data.

5340. ORGANIC AND PESTICIDAL RESIDUES.
(5 cr;prereq 1122, sr or #)
The fate of crop residues, animal wastes, sewage materials, petroleum hydrocarbons, detergents, and pesticides in soils with emphasis on the chemical, physical, and biological factors of the soil that influence decomposition or persistence.

5424. APPLIED CLIMATOLOGY.
(3 cr;prereq 5140 or Geog 3421 or #)
Intended for advanced undergraduates and beginning graduate students who have a background in the principles of climatology or microclimatology. Sources of climatic data, methods of analysis, and selected set of specific applications that focus on agricultural and environmental management problems.

5532. SOILS AND THE ECOSYSTEM.
(5 cr;may be taken in place of EBB 5819;prereq course in ecology;offered at Itasca in summer)
Functional and structural aspects of soils as a component of the ecosystem. Interrelationships of soil and vegetation on the landscape.

5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.
(3 cr;prereq 1122 or #)
Formation, properties, and management of peatlands important to crop,forestry, and energy production in this state and worldwide. Lectures.

5560. USES AND INTERPRETATION OF SOIL SURVEY INFORMATION.
(3 cr;prereq 3520 or #)
Techniques used in preparing soil maps of varying scales. Information available from soil maps and accompanying reports evaluated for use in agriculture, engineering, waste treatment, forestry, and land planning. How soil survey information can be used to the fullest extent by both laypersons and the scientific community.

5570. FIELD TOUR OF MINNESOTA SOILS.
(3 cr;prereq 3520 or #)
Two-week field tour of both northern and southern Minnesota's soils. Soil formation, soil profiles, land use and management practices discussed while visiting representative soils. Travel expenses are student's responsibility.

UNIVERSITY COLLEGE (UC)
317 Walter Library
CONTACT John Schneeweis, 213 Temporary North of Appleby, 376-1253

3075. INDEPENDENT STUDY.
(ar cr, prereq ^)
Student designs his or her own project and works with an appropriate faculty member who supervises and evaluates the project. May be take for 3 to 15 degree credits.

VETERINARY BIOLOGY (VB)
College of Veterinary Medicine
295K Animal Science/Veterinary Medicine Building
CONTACT Patrick T. Redig, 295B Animal Science/Veterinary Building, 373-0821

5330. WILD BIRD MEDICINE.
(2 cr;prereq regis vet med, 3rd or 4th year or grad student or #)
Brief summary of important aspects of avian anatomy and physiology. Survey of diseases common to wild birds and surgical repair of common injuries and fractures.

VETERINARY PATHOBIOLOGY (VPB)
College of Veterinary Medicine
239c Veterinary Science

5603s. PARASITES OF WILDLIFE.
(3 cr;prereq #;offered 1985 and alt yrs)
Biologic relationships of animal parasites to disease of regional wildlife.

5640s. DISEASES OF WILDLIFE.
(3 cr;offered 1984 and alt yrs)
Economic and biologic relationships of infectious and noninfectious diseases of wildlife.

PART III: SPECIAL CENTERS, SERVICES AND LIBRARIES

JAMES FORD BELL MUSEUM OF NATURAL HISTORY

Harrison B. Tordoff, Director, 10 Chruch Street S.E., University of Minnesota, Minneapolis, Minnesota 55455, phone (612) 373-2423.

The museum manintains exhibits and public education programs on natural history and supports research in ecology, systematics, paleontology, and behavior of vertebrates. A natural history library that emphasizes collections in vertebrate zoology, behavior, and basic ecology is located in the museum.

The museum also houses the Field Biology Program, administrered by the College of Biological Sciences. The Cedar Creek Natural History Area (located at Bethel, Minnesota) is a field resource administrered by the University with assistance from the Minnesota Academy of Sciences; it is open to qualified scientists for research purposes. Information on the Lake Itasca Forestry and Biological Station summer session is available in a special University bulletin that is published each year.

DEPARTMENT OF CONFERENCES

M. Alan Brown, Director, 131 Nolte Center for Continuing Education, 315 Pillsbury Drive S.E. University of Minnesota, Minneapolis, Minnesota 55455;phone (612) 373-3151.

The Department of Conferences, with support from the University of Minnesota academic faculty, assists groups in developing and presenting continuing education programs.

The department has a professional staff to assist interested parties in planning, publicizing, administration, and evaluation of continuing education programs.

CONTINUING EDUCATION IN PUBLIC POLICY

William Rogers, Director, 306 Westbrook Hall, 77 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455;phone (612) 373-3799

Continuing Education in Public Policy occasionally sponsors programs for the general public in the field of environment, urban problems, and planning. For further information, contact the director.

ENVIRONMENTAL PATHOLOGY LABORATORY

Vincent F. Garry, M.D., Director, 421 29th Avenue S.E. (Stone Laboratories). University of Minnesota, Minneapolis, Minnesota 55414; phone (612) 376-4856.

The Environmental Pathology Laboratory is jointly operated by the Department of Laboratory Medicine and Pathology of the School of Medicine and the School of Environmental Health. The goals of the Environmental Pathology Laboratory are to provide laboratory investigation of human environmental disease, carry out our research in the identification, diagnosis and prevention of human environmental problems, and serve as an educational resource for physicians, health professionals and interested members of the community. The laboratory performs basic gene toxic assays to determine mutagen, carcinogen exposure. Offers graduate level course in pathophysiology of environmental disease. Summer undergraduate research experience is available in the laboratory.

GRAY FRESHWATER BIOLOGICAL INSTITUTE

Richard S. Hanson, Director, P.O. Box 100, County Roads 15 and 19, Navarre, Minnesota 55392; phone (612) 471-8476

The Gray Freshwater Biological Institute is a multidisciplinary unit drawing faculty members from biochemistry, botany, and microbiology. The Institute, administered by the College of Biological Sciences, has two major responsibilities: to conduct fundamental research on freshwater related systems and to train undergraduate students, graduate students and postdoctorals drawn from the various disciplines. The institute's core program emphasizes modern techniques of microbiology, biochemistry, molecular biology and molecular spectropscopy.

LIMNOLOGICAL RESEARCH CENTER

Herbert Wright, Director, 220 Pillsbury Hall, 310 Pillsbury Drive S.E. University of Minnesota, Minneapolis, Minnesota 55455; phone (612) 373-4508.

This center conducts research on the physical, chemical, biological, and geological aspects of lakes, especially those in Minnesota. Studies of lake history are made through analyses of microfossils and of the chemical and mineral components of sediments.

An evening seminar on current problems in limnological research is presented every winter quarter. Courses and degree programs in limnology are coordinated primarily through the Departments of Geology and Ecology and Behavioral Biology.

MINNESOTA GEOLOGICAL SURVEY

Matt S. Walton, Director, 2642 University Avenue, St. Paul, Minnesota 55114; phone (612) 373-8372

The Minnesota Geological Survey is engaged in a number of activities related to the environment and planning. These include developing a data base of waterwell logs and groundwater data for the state of Minnesota; compiling subsurface engineering geological maps for siting major structures and developing underground systems; studying the geological environment of Minnesota's peat resources in connection with the state's peat inventory program; and preparing for selected county atlases containing geological, hydrogeological, physiographic, resource, land suitability and other maps and data useful for environmental planning and management.

Students are employed by the survey as aides and research assistants. Whenever possible their work forms part of the research for a master's thesis or PhD dissertation. Thus the Minnesota Geological Survey is a potential source of employment and research support in geologically related aspects of the environment and planning.

The Minnesota Geological Survey maintains a complete inventory of topographic and geologic maps of the state, as well as publications on the state's geology and resources. For further information, contact the director.

MINNESOTA PUBLIC INTEREST RESEARCH GROUP (MPIRG)

Kristan Blake, Executive Director, 2412 University Avenue S.E., Minneapolis, Minnesota 55414 (campus office in Coffman Union, Minneapolis Campus); phone (612) 376-7554.

MPIRG is a nonprofit, nonpartisan organization representing Minnesota college studetns and working for constructive social change to benefit all Minnesotans. MPIRG activities focus on such issues as environmental protection, consumer protection, health care delivery, housing, human rights, occupational safety, and similar matters in the public interest.

MPIRG is funded by nearly 55,000 students on 9 Minnesota college and university campuses who pay a special fee for its support.

MPIRG is directed by a board of elected student representatives from the participating institutions. The board holds open meetings at least once a month. All matters of organizational business-from hiring staff, to allocating $200,000 annual budget, to selecting projects for the organization-are handled by the board. Any enrolled, fee-paying student may seek election to the board. Annual elections are held in the spring.

MPIRG employs full-time staff of fourteen people including attorneys, researchers, organizers and support staff.

MPIRG publishes a monthly newspaper, the Statewatch. MPIRG sponsors coursework on advocacy - on campus, in communities, and with the legislature. It also provides numerous interships.

After careful investigation of selected problem areas, the MPIRG professional staff members and student participants work together in coordinated programs that involve publication of research findings and recommendations for public action, active representation before government administrative and regulatory agencies, law reform through legislative action, and, where necessary, legal action through courts.

PHYSICAL PLANT ENVIRONMENT ENGINEERING

Robert A. Sivagni, Environmental Engineer, Physical Plant Operations, 200 Shops Building, 319 15th Avenue S.E., Minneapolis, Minnesota 55455; phone (612) 373-0392.

The University Physical Plant, which maintains facilities equivalent to those of a major Minnesota city, provides an opportunity for students to investigate practical environmental engineering problems and principles. All possible support is given to students who wish to explore the application of environmentally related innovations at the University. Credit may be earned for worthy projects of sufficient difficulty when arranged through appropriate departments. These projects include studies and "hands-on" field work in the areas of solid waste management, air pollution control, waste water treatment, chemical waste treatment, and waste recycling.

CENTER FOR POPULATION STUDIES

Harry Foreman, Director, 12-186 Malcolm Moos Health Sciences Tower, 420 Delaware Street S.W. University of Minnesota, Minneapolis, Minnesota 55455; phone (612) 373-9656.

The center coordinates graduate programs in family planning administration and in population studies.

ST. ANTHONY FALLS HYDRAULIC LABORATORY

Heinz Stefan, Associate Director, Mississippi River at 3rd Avenue S.E., Minneapolis, Minnesota 55414; phone (612) 373-2782.

The St. Anthony Falls Hydraulic Laboratory conducts research on the flow of water in streams, rivers, estuaries, lakes, and man-made pipes, channels, and reservoirs. Transport of sediment, heat, and dissolved substances as well as natural and artificial water storage, drainage, runoff, and other hydrological processes are part of the research program.

In its 45 year history the Laboratory staff, comprised of Civil and Mineral Engineering Department faculty, civil service employees, and graduate and undergraduate students, has conducted hundreds of studies on water-related projects locally, nationally, and internationally. An extensive documentation is available through reports and films of the research studeis in the Lorenz G. Straub Memorial Library.

The laboratory provides academic and financial assistance to graduate and undergraduate students interested in water resources engineering and related programs.

OFFICE FOR SPECIAL LEARNING OPPORTUNITIES (OSLO)

220 Johnston Hall, 101 Pleasant Street S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone (612) 373-7550.

Independent study and field learning assistance.

UNDERGROUND SPACE CENTER

Raymond L. Sterling, Director, 790 Civil and Mineral Engineering Building, 500 Pillsbury Drive S.E., University of Minnesota, Minneapolis, Minnesota 55455; phone (612) 376-5341.

The Underground Space Center is a division of the Department of Civil and Mineral Engineering. The center was founded in November 1977 by the Minnesota Legislature in response to the growing interest in many aspects of underground space utilization.

The goals of the center are to: serve as a focal point for planning and coordination of underground space use; carry out research in areas affecting underground space use; provide an information and referral service for all aspects of underground space utilization and serve as a focal point for international cooperation or research and information transfer.

One of the major activities of the center is conducting research and providing information on earth-sheltered housing; the first report from the center was a book of guidelines for the design of such houses. Further information and a number of publications (including the guidelines) are available from the center.

The Underground Space Center offers two courses on earth-sheltered building design and underground contruction engineering; these courses are listed under the Civil Engineering Department's fall and winter class schedule. Energy use, planning, security, environment, building design, landscaping, building codes, financing and psychological considerations are topics, studies and discussions in these courses.

CENTER FOR URBAN AND REGIONAL AFFAIRS (CURA)

Thomas M. Scott, Director, 1972 South Fifth Street, University of Minnesota, Minneapolis, Minnesota 55454; phone: (612) 373-7833.

The regents established the Center for Urban and Regional Affairs to help make the University more responsive to the needs of the larger community and to increase the constructive interaction between faculty and students, on the one hand, and between the University and those dealing directly with major public problems, on the other hand.

The specific projects of the center are selected from several broad problem areas reflecting major concerns in this region; housing, human relations, environment, energy, transportation, land use management, local government organization, and the diffusion of information about these topics. These problems cut across a wide and changing array of disciplines.

CURA's role is to help coordinate and stimulate projects in these problem areas. It works with the faculty and students of all academic units of the University. All CURA programs are pilot, experimental, or short term projects. The goal is to probe and evaluate, complete short-term projects, discard unsuccessful ones, and help build successful ones into the appropriate part of the academic structure. CURA does not have a permanent faculty or research staff and does not offer degrees. It confines itself to projects for which there is currently no other practical administrative home.

The center alos publishes a newsletter, the CURA Reporter. Information about both the newsletter and the center may be obtained from the CURA office.

WATER RESOURCES RESEARCH CENTER

George R. Blake, Director, 866 Biological Sciences Center, 1445 Gortner Avenue, St. Paul, Minnesota 55108; phone (612) 376-5668.

The Water Resources Research Center was established in the Graduate School in 1964. The center has responsibility for stimulating water resources research at the University of Minnesota and at state and private colleges through administration of funds associated with the Federal Water Resources Research Act of 1964; coordinating the research with programs of local, state, and federal agencies and private orgainzations throughout the state, and assisting in training additional scientists for work in the field of water resources through research. The following state and private colleges participate or have participated in the center's programs: St. Mary's College, St. Cloud

State University, Gustavus Adolphus College, Bemidji State University, Winona State University, Mankato State University, and Concordia College.

The center does not conduct research, nor does it have research facilities. The center supports water resource research activities of departments and schools and assists in expanding interdisciplinary research. It plans and arranges for divisions of the University of Minnesota and state universities and private colleges to conduct competent research of either a basic or practical nature in relation to the physical-biological-economic-social-political aspects of water resources.

One of the purposes of the center is to stimulate and review educational offerings that will prepare students for careers in the field of water resources. The center assists in recruiting students and in guiding them into appropriate programs of study. The center has been helpful to the University in developing many new courses in the area of water resources, a new graduate option in hydrology, and a graduate program in water resources.

The center publishes and distributes quarterly newslwtters and information circulars to people thoughout the state. Research projects generate many technical reports and theses. Upon request, the center distributes copies of its publications to people throughout the state and nation. To provide an opportunity for professional people and students working in the field of water resources to meet and exchange information, the center also sponsors interdisciplinary seminars and short courses.

LIBRARIES

UNIVERSITY LIBRARIES-TWIN CITIES

The research collections that support the courses and programs in the environment are found throughout the 32 libraries which compromise the University Libraries. The five major library units and their respective environmentally-related collections are:

Bio-Medical Library (East Bank/Diehl Hall): Contains environmentally-related materials in the fields of health sciences, including microbiology, pharmacology, environmental health, and genetics.

Institute of Technology Libraries (East Bank): The eight separate subject libraries - architecture, chemistry, engineering, geology, mathematics, and physics - contain environmentally-related information ranging from urban design to water pollution to transportation to environmental geology.

Law Library (West Bank/Law): Contains environmental law materials.

St. Paul Campus Libraries (St. Paul Campus): The five libraries on the St. Paul Campus contain environmentally-related materials in the broad fields of agriculture, biochemistry, forestry, wildlife, vegetation, veterinary medicine, design, and home economics.

Walter Library (East Bank): Contains environmentally-related collections in education, sport, recreation and psychology.

Wilson Library (West Bank): Contains environmentally-related collections in a broad range of social sciences and humanities, including economics, political science, sociology, anthropology, philosophy, and history. Government documents, maps and the business collection are also located in Wilson

In addition to strong collections, the University Libraries offers a full range of reference and information services including specialized reference assistance and data base literature searching. Inquire at any library.

ENVIRONMENTAL CONSERVATION LIBRARY (ECOL)

Minneapolis Public Library, 300 Nicollet Mall, Minneapolis, Minnesota 55401; phone 372-6609.

ECOL, a special collection within the Minneapolis Public Library, brings together materials from various subject fields that relate to the physical environment and human impact on it. ECOL has books, periodicals, newsletters, pamphlets, bibliographies, posters, and government documents relating to such topics as air and water pollution, solid waste, wildlife, conservation of natural resources, land use planning, environmental law, energy resources, and environmental education. ECOL was designated by the Minnesota

Legislature as a state center for environmental information and receives publications of many state agencies, including environmental impact statements. ECOL serves as the local public document room for U.S. Nuclear Regulatory Commission materials relating to nuclear power plants in Minnesota. A catalog of the collection has been printed, and copies are available in libraries on all campuses of the University.

Two large collections of full documents and articles on microfiche are available for use and loan. Entitled Envirofiche and Energyfiche, they are keyed to the abstract journals Environment Abstracts and Energy Information Abstracts.

MINNESOTA DEPARTMENT OF HEALTH LIBRARY

717 Delaware Street S.E., Minneapolis, Minnesota 55440; phone 623-5090.

This collection has been developed with the needs of public health professionals in mind. Consequently, it is essentially a specialized library with technical, as opposed to popular literature. It is a reference collection only and extends no loan privileges. The library subscribes to some 200 periodicals. Hours are 8:00 - 4:30 M-F. A photocopy machine is available.

MINNESOTA ENERGY AND ECONOMIC DEVELOPMENT LIBRARY

900 American Center Building, 150 East Kellogg Boulevard, St. Paul, Minnesota 55101; phone (612) 296-8902.

This research library has a noncirculating collection, although some items may be borrowed throught the MINITEX system. The library receives 95 percent of the NTIS energy reports listed in Government Reports Announcements abstracts and in microfiche automatically and will loan these. The collection contains United States and Minnesota statistics of energy use. Department of Energy reports, and approximately 200 periodicals. There is strong emphasis on energy conservation reports as well as energy forms. The library has environmental information on coal development, electric power, nuclear power, solar, etc.

This library is also starting a collection on economic development issues including high technology, location of industry, and business conditions with materials discussing Minnesota, other states, and U.S. conditions.

MINNESOTA POLLUTION CONTROL AGENCY LIBRARY

1935 W. County Road B-2, Roseville, Minnesota; phone 296-7719.

This collection has been developed with the needs of professional pollution control engineers in mind. Therefore, it is essentially a technical library with few subprofessional materials. The library extends reference services.

POPULATION RESOURCE CENTER LIBRARY

1965 Ford Parkway, St. Paul, Minnesota 55116; phone 698-2401.

The Population Resource Center is a multimedia library of materials on population growth, human sexuality, sociology of family planning, abortion, contraceptive technology, history of birth control movement, and related subjects.

The collection is available to students, the general public, teachers, and health professionals, and includes more than 1600 books, 60 journal subscriptions, many reprints and articles, more than 100 types of pamphlets for public distribution and sale, and approximately 100 films and filmstrips.

A mailing service is maintained so that persons outside the Twin Cities have access to resource center materials. A quarterly publication, What's New... in the Population Resource Center, that lists current materials and recent acquisitions is mailed to 1200 people throughout the state.

A card catalogue helps users find materials. All journal articles pertinent to the collection are filed for quick and easy reference. Books may be borrowed at no charge. The Resource Center Guide listing films and materials is available free of charge.

Internships are available in areas of family planning.