College of Engineering and Architecture

Engineering Center 203 (701) 231-7494
Otto J. Helweg, Dean

The vision for the College of Engineering and Architecture is to provide leadership in education and research in the fields of engineering and architecture and to achieve a national reputation in selected areas. The college also will enhance the economy, environment, and society of the region through the development, communication, and application of knowledge in engineering and architecture.

The mission of the College of Engineering and Architecture is to provide outstanding education, research, and service to students, alumni, state residents, research partners, businesses, organizations, and government. Further, college faculty will provide leadership in economic development by transferring technology and by providing information and innovative design. College goals:

• Deliver quality undergraduate and graduate education by creating and utilizing effective instruction and by demonstrating commitment to each student's development.
• Encourage continuous learning among faculty, students, alumni, and the public.
• Develop distance education and continuing education for professionals seeking to upgrade skills.
• Provide laboratories and studios to facilitate quality education, research, and creativity.
• Foster research with an emphasis on engineering applications and creative design that most directly serves the region and influences the global community.
• Pursue niches of research opportunity and develop an industry/college learning center.
• Serve citizens, businesses, and industry in the region by providing professional expertise, outreach, and partnerships.

The departments include Agricultural and Biosystems Engineering, Architecture and Landscape Architecture, Civil Engineering and Construction, Electrical and Computer Engineering, Industrial and Manufacturing Engineering, and Mechanical Engineering.

Accreditation

The facilities and curricula of the college are inspected periodically by the Accreditation Board for Engineering and Technology, the National Architectural Accrediting Board, the American Council for Construction Education, and the Landscape Architecture Accreditation Board. These organizations are recognized national accrediting agencies for the engineering, architecture, landscape architecture, and construction curricula.

Admission Requirements

Applicants for admission must satisfy the general admission requirements of the University and the special requirements of the college and department. Students who enter with deficiencies in high school mathematics are registered for special programs to correct these deficiencies. Admission to the architecture and landscape architecture programs is selective after the first year. Applicants should obtain information regarding the method of application from the NDSU Office of Admission and the Department of Architecture and Landscape Architecture.

Degree Programs

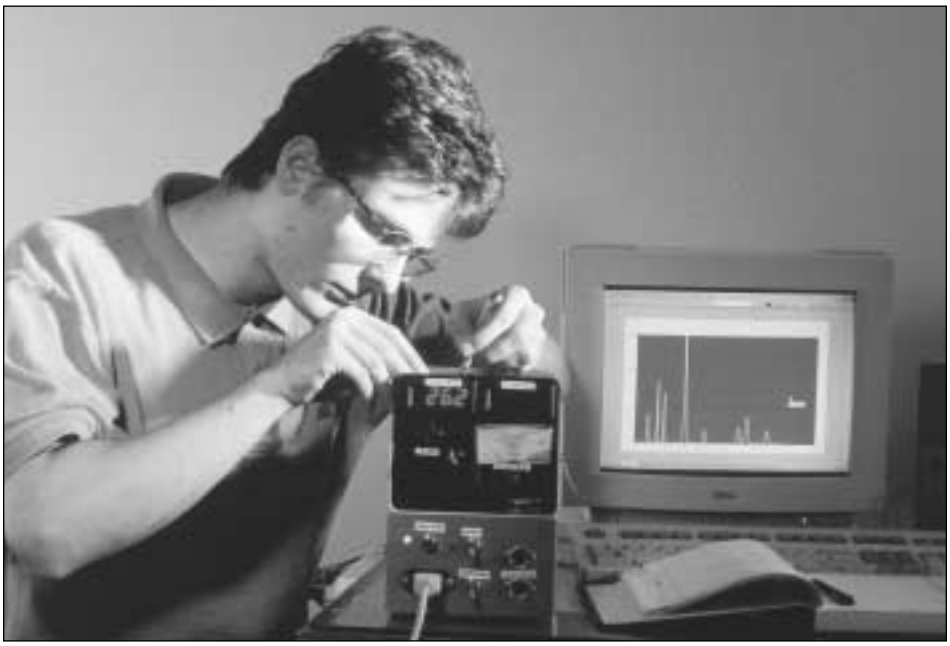
Undergraduate programs of study lead to the Bachelor of Science degree in the specific fields of agricultural and biosystems engineering, civil engineering, computer engineering, construction engineering, construction management, electrical engineering, environmental design, industrial engineering and management, manufacturing engineering, and mechanical engineering. A five-year professional degree completes the programs in architecture and landscape architecture. Each of the curricula includes a number of options for specialized study.

The college has developed its programs of study to provide an educational experience in keeping with the professions of architecture, landscape architecture, and engineering. The classrooms, studios, and laboratories are well-equipped and every effort is made to keep them abreast of current technology. Graduates successfully apply for registration as professional engineers or architects after minimum periods of professional experience. Examinations of the North Dakota State Board of Registration for Engineers and Architects are given on the campus each year. All engineering seniors are encouraged to take the examinations as soon as they are eligible.

Graduate courses are available in most departments. Programs of study may be arranged leading to the Master of Science degree in the engineering fields and to the Master of Architecture degree. The Doctor of Philosophy in Engineering degree is a single doctoral program in the College of Engineering and Architecture administered by the Graduate School and the College of Engineering and Architecture. A number of graduate assistantships are available to students undertaking graduate study. Detailed information concerning graduate study is in the Graduate Bulletin.

Degree Requirements

To earn a baccalaureate degree from any of the engineering programs or the construction management program, a student must complete at least 60 semester credits of upper-division course work in his/her program while in residence and enrolled in the college. Students transferring into the college from programs with professional accreditation are exempt from the residence requirement, but subject to NDSU's residence policy. Other exemptions must be approved by the college.



Special Opportunities and Services

The college serves both students and the public. Special opportunities include the following.

General Program

The general program of the College of Engineering and Architecture is designed to allow students, who have not chosen the branch of engineering they wish to study, to take basic courses for one year. Students are encouraged to select an engineering curriculum as soon as possible, but no later than the end of their first year.

ROTC Programs

Up to 18 semester credits may be earned by participation in the Army or Air Force ROTC programs. Men and women may enroll in these programs for partial elective credit. In addition, they may complete either program and receive a commission upon graduation. Students receiving commissions will have the opportunity to serve as officers in active service or in army reserve components.

Student Societies and Organizations

American Society of Agricultural Engineers, American Society of Civil Engineers, American Society of Landscape Architects, American Society of Mechanical Engineers, Associated General Contractors, Institute of Electrical and Electronic Engineers, Institute of Industrial Engineers, Institute of Transportation Engineers, National Association of Home Builders, Society of Automotive Engineers, and the Society of Women Engineers are actively supported for the benefit of students in the related curricula. All students are eligible to join one or more of these organizations.

The Student Engineering and Architecture Council plans and administers many extracurricular student activities and is composed of elected representatives from the student societies.

Several national professional honor societies have chapters on the campus for which students with high academic attainments are eligible in their junior or senior years. Eligible students are selected for Tau Beta Pi from all engineering curricula, Tau Sigma Delta from architecture, Alpha Epsilon from agricultural engineering, Eta Kappa Nu from electrical engineering, Alpha Pi Mu from industrial engineering, Sigma Alpha Lambda from Landscape Architecture, Sigma Lambda Chi from construction management and engineering, and Pi Tau Sigma from mechanical engineering. Membership in these societies is a coveted honor and highly regarded in the engineering and architectural professions.

The Engineering and Architecture Experiment Station and Extension Service

Research and development projects are administered by an executive staff responsible for general policies, publications, and cooperative relations with private and governmental agencies.

Executive Staff

Director, Otto J. Helweg, PE
Agricultural and Biosystems Engineering, Earl C. Stegman, PE
Architecture, Paul H. Gleye
Civil Engineering, G. Padmanabhan, PE
Electrical and Computer Engineering, Daniel Ewert
Industrial and Manufacturing Engineering, David Wells
Mechanical Engineering, Robert V. Pieri

Special research activities and projects of the college are coordinated through the Experiment Station. The professional services of faculty and the facilities of the college are available to both private and governmental agencies for research and development studies on engineering or architectural problems. Research projects of individual faculty members are sponsored and promoted by the station.

The Engineering Extension Service provides special educational project services to adult groups in conferences, workshops, short courses, and publications. The laboratory facilities of the college are available for specialized instruction under the supervision of faculty. Organizations planning educational programs or special projects for their members are invited to consult the service for assistance.

Aerospace Studies (Air Force ROTC)

The Air Force Reserve Officer's Training Corps (AFROTC) program is conducted by the Department of Aerospace Studies. The purpose of this program is to enable qualified undergraduate and graduate students to become commissioned officers in the United States Air Force.

AFROTC learning experiences will be of long-range value whether one pursues a military or civilian career. Upon graduation and completion of the AFROTC curriculum each student is commissioned a second lieutenant in the United States Air Force.

The initial assignment options available to the Air Force second lieutenant include the following:

1. Enter the Air Force and complete the designated technical training course prerequisite to the student's specialty, i.e., flight training, research and development, management, or support functions.

2. Apply for a delay in entering active duty for the purpose of pursuing an advanced degree.

3. Enroll in one of several Air Force sponsored graduate study programs while serving with full pay as an Air Force officer.

The aerospace studies curriculum is divided into two courses of instruction: the General Military Course (GMC), which parallels the freshman and sophomore academic years, and the Professional Officer Course (POC), which parallels the junior and senior academic years. Students in the four-year program normally attend four weeks of field training at a designated Air Force base during the summer between their sophomore and junior years. The student who chooses not to enroll in the GMC (first two years) may still earn a commission by enrolling in a special two-year program during the junior and senior years. Admission to this special program requires the student to make application early in the sophomore year. Qualified students will then participate in a five-week field training program at an Air Force base the summer prior to their junior or senior year.

Cadets enrolled in the Professional Officer Corps (POC) receive $350 per month during their junior academic year and $400 per month during their senior academic year. AFROTC college scholarships are awarded to the best-qualified students and range in length from one to four years. These grants cover the cadet's tuition, incidental lab fees and textbooks — plus a tiered monthly allowance. Incentive scholarships also are available for students not already on scholarship.

Upon entering the Air Force, students who are selected to the pilot program will receive 48 weeks of pilot training.

Satisfactory completion of the four-year Air Force ROTC program, 16 credits, constitutes a minor in Aerospace Studies.

Agricultural and Biosystems Engineering

The agricultural and biosystems engineering (ABEN) major is designed to educate men and women for careers that require the application of engineering, physical, and biological sciences to problems that involve living systems. Agricultural and biosystems engineers plan, design, develop, and test engineered products or systems for agricultural and biological industries and related environmental areas. Typical examples include mechanization and automation of agricultural production equipment and processes, design for food processing and packaging, storage systems for agricultural and other biological materials, environmental systems for plant and animal production, and natural resource management systems to improve environmental quality. Advances in biotechnology have created new opportunities for agricultural and biosystems engineers in biological and chemical production and the processing of biological materials.

The educational objectives of this major are to provide students with: a) technical knowledge and problem solving skills that are foundational to engineering, b) educational experiences that build interpersonal skills and the capacity for productive careers, and c)disciplinary knowledge and the educational depth and breadth to deal with changing career opportunities. These objectives support the departmental mission of developing and extending knowledge through engineering and technology that advances the productivity of agricultural production, the processing and utilization of agricultural commodities and related biological materials, and the sustainment of environmental resources management.

The curriculum is based on a core of engineering sciences, mathematics, and basic sciences. By selecting appropriate electives, students may emphasize areas such as agricultural systems, environmental systems, biomaterials and food processing systems, or an emphasis area designed by the student and his or her adviser.

Agricultural systems emphasis: This emphasis is focused on courses in machinery, power, structural, electronic and sensor systems to prepare students for positions related to engineering for improved food, feed, and fiber production.

Biomaterials and food processing emphasis: With this emphasis, students prepare for engineering positions in the rapidly expanding industries that handle and process biomaterials for food and non-food products and that create new applications of sciences in biotechnical, bioresource, and bioenvironmental fields.

Environmental systems emphasis: This emphasis is focused on the preparation of students for positions in environmental engineering, natural resources management, irrigation engineering, watershed management, and waste management.

Electives: Elective opportunities also are available in information and electronic systems and computer aided design. Students select elective courses with the individualized assistance of faculty advisers.

The faculty also assist with career development and job placement of graduates. Students interested in careers involving delivery, management, and technical support of systems for food, agricultural, or closely related industries rather than engineering or design should consider the agricultural systems management major offered by the College of Agriculture.

Recommended Curriculum Agricultural and Biosystems Engineering

	Credits	
First Year	**F**	**S**
ABEn 110, Intro to Ag and Biosys Engr	2	
ABEn 189, Skills for Academic Success	1	
Chem 121, 122, Gen Chem I, II	3	3
Engl 110, 120, College Composition I, II	3	3
Math 165, 166, Calculus I, II	4	4
Humanities/Fine Arts Elective	3	
ABEn 496, Field Experience		1
ME 212, Fund of Visual Communications		3
ME 221, Engineering Mechanics I		3
Totals	16	17
Second Year		
ABEn 255, Comp Aided Anal & Design	3	
ABEn 263, Biomaterials Processing		3
Biol 150, General Biology	3	
CE 309, Fluid Mechanics		3
Math 228, Intro to Linear Algebra	1	
Math 259, Univ Calc III	3	
Math 266, Differential Equations		3
ME 222, Engr Mech II	3	
ME 223, Mech of Materials	3	
Phys 252, 252L, Univ Phys II, Lab		4,1
CSCI Programming Elective		3
Totals	16	17
Third Year		
ABEn 377, Modeling in ABEn		3
CE 310, Fluid Mechanics Lab	1	
ECE 301, Electrical Engineering I	3	
ME 350, Thermodynamics & Heat Trns		3
Comm 110, Fund of Pub Speaking	3	
ABEn Electives	3	3
IME 440, Engineering Economics	2	
Biological Science Elective	3	
Social/Behavioral Sciences Elective		3
Statistics Elective	3	
Technical Electives		6
Totals	18	18
Fourth Year		
ABEn 482, Instrument & Measurements		3
ABEn 486, 487, Design Project I, II	1	2
ABEn 491, Seminar	1	
Engr 402, Professional Ethics		1
ABEn Elective	3	
Technical Electives	6	3
Biological Science Elective	3	
Humanities/Fine Arts Elective		3
Social/Behavioral Sci Elective	3	
Business/Communication Elective		3
Wellness		2
Totals	17	17
Curriculum Total		136

Agricultural and Biosystems Engineering Electives:
ABEn 358 - 3, Electrical Energy Applications
ABEn 383 - 3, Structural Design for Biosystems
ABEn 452 - 3, Bioenvironmental Systems Design
ABEn 458 - 3, Food Process Engineering
ABEn 464 - 4, Resource Conservation and Irrigation Engineering
ABEn 473 - 3, Agricultural Power
ABEn 478 - 2, Machinery Analysis and Design

Technical Electives:
Students consult their adviser for approved courses according to their career interests and/or a selected emphasis area.

Agricultural Systems: engineering for advancing productivity of food, feed, and fiber production; emphases may include power and machinery systems, machine design, manufacturing, structures and environment control, computer aided design, electrical and electronic systems, and instrumentation and measurements.

Biomaterials and Food Processing Systems: engineering for quality maintenance, new uses, or enhanced utilization of agricultural and related biological materials; emphases may include engineering properties of biological materials, biological materials processing, food process engineering, waste management, and bioprocessing.

Environmental Systems: engineering for responsible use and sustainable management of environmental resources; emphases may include hydrology, soil and water resource conservation, irrigation engineering, water and wastewater engineering, and water quality management.

Architecture

The architect must combine an understanding of society, artistic skill, and technological knowledge to shape places and spaces that enrich human life. Not only do the physical workday requirements need to be satisfied, but there must be beauty to house the human spirit. All of this requires a creative thought process that can balance and organize needs that are quite varied in nature. Clear, responsible, sensitive, and comprehensive thinking is demanded of the architect who is to integrate a wide range of factors into a design that is meaningful. For this reason an architect's education must range from the practical aspects of building construction to the study of environmental, social, and visual effects.

In addition to required courses that relate closely to architecture itself, 20 percent of the credits required for the Bachelor of Architecture degree is electives. There are courses that the student chooses, either within categories or with little restriction, except for the requirement that a portion of them be selected to pursue a single special interest. With the remainder of the elective credits, a student is encouraged to gain the broad general education that is needed for the architectural profession.

Central to the study of architecture is the sequence of architectural studio courses. Students are assigned or select architectural problems, which may be hypothetical, realistic, or theoretical, and find their own solutions to them with frequent individual consultations with instructors. As the student progresses, the projects become larger and more complex or the solution becomes more detailed. In this way, knowledge and experience acquired in other classes are brought to bear on the principal responsibility of the architect and the architecture student, that of shaping separate considerations into a single design.

Selective Admission

Selective admission into the architecture program at NDSU takes place through a two-step process. Step one: High school students entering as freshmen are evaluated on the basis of their high school record and test scores, while transfer students are evaluated on the basis of courses taken and grades received. Step two: Upon completion of the first year a selected number of students are admitted to the second year of the program on the basis of overall GPA attained and performance in first-year architecture courses.

The Program

A five-year undergraduate program leading to the Bachelor of Architecture degree is offered through the department. This program is fully accredited by the National Architectural Accrediting Board and the degree is recognized by the National Council of Architectural Registration Boards as a first professional degree. At the end of four years a student may elect to receive a Bachelor of Science in Environmental Design (non-professional degree).

The total number of credits required for the professional degree is 160 and the four-year degree requirement is 129.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. The NDSU architecture program is accredited, based on conformance with established educational standards.

The four-year pre-professional degree, where offered, is not accredited by NAAB. The pre-professional degree is useful for those wishing a foundation in the field of architecture as preparation for either continued education in a professional degree program or for employment options in architecturally related areas.

Special Notice

Students who are admitted into the second year of the program will be required to purchase a laptop computer. Information on type of computer, software, purchase, and financing arrangements will be distributed to admitted students prior to purchase.

Recommended Curriculum Bachelor of Architecture

	Credits	
First Year	**F**	**S**
Anth 111, Intro to Anthro	3	
Arch 132, Graphics		2
Arch 171, 172, Envir Design I, II	3	3
Art 130, Drawing I		3
Comm 110, Fund Public Speaking	3	
Engl 110, 120, College Composition I, II	3	3
Math 104, 105, Finite Math, Trig	3	3
Soc 110, Intro to Sociology		3
Univ 189, Skills for Academic Success	1	
Totals	16	17
Second Year		
Arch 299/231, Digital Means	2	
Arch 271, 272, Arch Design I, II	4	4
Arch 321, 322, Arch History I, II	3	3
Arch 326, Design Process and Methods		2
Phys 120, Fund of Physics		3
Psyc 111, Intro to Psyc	3	
General Education Electives	3	4
Wellness	2	
Totals	17	16
Third Year		
Arch 341, 342, Arch Structure I, II	3	3
Arch 351, Materials and Const.	4	
Arch 352, Envir Cont Sys		4
Arch 371, 372, Arch Design III, IV	4	4
LA 341, Site Dev and Det I	3	
General Educ or Humanities Electives	3	6
Totals	17	17
Fourth Year		
Arch 451, Envir Cont Sys II	3	
Arch 452, Constr Detailing		3
Arch 471, 472, Adv Arch Design I, II	5	5
Arch 521, 522, 523, 524, 525, 526, 527, 528, Hist/Theory Seminar		2
300 - 500 Level Electives	6	6
Totals	14	16
Fifth Year		
Arch 561, Arch Programming	2	
Arch 571, 572, Adv Arch Design III, IV	6	8
Arch 582, Prof Practice	2	
Arch 589, Prof Seminar	2	
300 - 500 Level Electives	3	7
Totals	15	15
Curriculum Total		160

Note: Electives must include 6 credits of humanities, 6 credits of science plus a 1 credit lab, and 27 credits at the 300 - 500 level. Students must meet the university general education requirements as well as the curriculum requirements in effect at the time of entrance into the program. Two department approved humanities courses are required above and beyond general education.

Recommended Curriculum B.S. with a Major in Environmental Design

	Credits	
First Year	**F**	**S**
Anth 111, Intro to Anthro	3	
Arch 132, Graphics		2
Arch 171, 172, Envir Design I,II	3	3
Art 130, Drawing I		3
Comm 110, Fund Public Speaking	3	
Engl 110, 120, College Composition I, II	3	3
Math 104, 105, Finite Math, Trig	3	3
Soc 110, Intro to Sociology		3
Univ 189, Skills for Academic Success	1	
Totals	16	17
Second Year		
Arch 299/231, Digital Means	2	
Arch 271, 272, Arch Design I, II	4	4
Arch 321, 322, Arch History I, II	3	3
Arch 326, Design Process and Methods		2
Phys 120, Fund of Physics		3
Psyc 111, Intro to Psyc	3	
General Education Electives	3	4
Wellness	2	
Totals	17	16
Third Year		
Arch 341, 342, Arch Structure I, II	3	3
Arch 351, Materials and Const.	4	
Arch 352, Envir Cont Sys I		4
Arch 371, 372, Arch Design III, IV	4	4
LA 341, Site Dev and Det I	3	
General Educ or Humanities Electives	3	6
Totals	17	17
Fourth Year		
Arch 451, Envir Cont Syst II	3	
Arch 452, Const Detailing		3
Arch 471, 472, Adv Arch Design I, II	5	5
Arch 521, 522, 523, 524, 525, 526, 527, 528, Hist/Theory Seminar		2
300 - 500 Level Electives	6	5
Totals	14	15
Curriculum Total		129

Note: Electives must include 6 credits of humanities, 6 credits of science plus a 1 credit lab, and 25 credits at the 300 - 500 level. Students must meet the university general education requirements as well as the curriculum requirements in effect at the time of entrance into the program. Two department approved humanities courses are required above and beyond general education.

Landscape Architecture

The landscape architecture program is one of approximately 50 accredited programs in the United States and Canada. The curriculum is reviewed periodically by the nationally organized Landscape Architecture Accreditation Board and has been fully accredited since 1991.

Landscape architects provide a wide variety of professional services for individual clients, organizations, corporations, and government agencies. They are involved at every phase of the development of a site, from the initial discussion of ideas with the client through the supervision of construction for the project.

Master planning of parks, zoos, golf courses, playgrounds, and recreation areas are familiar projects for landscape architects. They may also design multi-functional areas for urban renewal projects, college campuses, industrial parks, new communities, natural areas, reclaimed lands, and wetlands.

Besides designing sites, landscape architects often select building locations, prepare cost estimates, initiate long-range planning studies, determine utility corridors, and prepare environmental impact statements for future construction. Whether specializing within a large firm of landscape architects or working in a small professional office, the landscape architect is often collaborating with other professionals, such as engineers, city-planners, and other architects.

Most landscape architects spend some of their time at the drawing board or computer. They also spend many hours in the field, investigating and analyzing potential project sites, developing field notes for design layouts, completing visual surveys, and supervising construction. It is at the computer and drawing board that projects are actually organized and shaped into a creative and imaginative solution. The work and responsibility of each landscape architect depends principally on individual interests and abilities. Opportunities may range from professional practice on a small scale to administration of governmental programs.

Those who plan careers in landscape architecture should be able to work independently, have a capacity for solving technical problems, be artistically inclined, and willing to learn computer use. They should be prepared to work in the competitive environment of the profession, where great value is placed on leadership and the ability to work effectively with others. The range of interests and knowledge required in the profession of landscape architecture is broad; therefore, the courses required of students include many fields of study options. A student

may specialize by selecting one of the options provided: Land Reclamation/Natural Resources Management, Landscape Construction and Technology, Rural Community Development, or Design and Communication. Students may also tailor their own option area with their academic adviser.

Selective Admission

Selective admission in the landscape architecture program at NDSU takes place through a two-step process. Step one: High school students entering as freshmen are evaluated on the basis of their high school record and test scores, while transfer students are evaluated on the basis of courses taken and grades received. Step two: Upon completion of the first year, a selected number of students are admitted to the second year of the program. The basis for selection is overall GPA and performance in first-year landscape architecture courses.

Special Notice

Students entering the second year of the program will be required to purchase a laptop computer. Information on type of computer, software, purchase, and financing arrangements will be distributed to students prior to purchase.

Recommended Curriculum Landscape Architecture

	Credits	
First Year	**F**	**S**
Anth 111, Intro to Anthro	3	
Art 130, Drawing I	3	
Comm 110, Fund of Public Speaking		3
CSci 114, Microcomp Packages		3
Engl 110, 120, College Composition I, II	3	3
LA 132, Intro to LA		2
LA 171, Envir Design I	3	
LA 172, Envir Design II		3
Math 104 or 146, Fin Math or Applied Calc I	3	
Univ 189, Skills for Academic Success	1	
Wellness		2
Totals	16	16
Second Year		
Biol 150, Gen Biology	3	
CE 113, Surveying		2
Engl 320, Practical Writing		3
Geol 105, 105L, Physical Geol I, Lab	3,1	
LA 271, 272, LA Design I, II	4	4
LA 299/231, Digital Means	2	
LA 331, Intro to Planting	3	
Psyc 111 or Soc 110, Intro to Psyc or Intro to Soc		3
Computer Science Elective		3
Totals	16	15
Third Year		
Arch 321, Arch History I	3	
LA 322, LA History I		4
LA 341, 342, 344, Site Dev & Det I, II, Lab	3	3,2
LA 371, 372, LA Design III, IV	4	4
PlSc 355, Woody Plants	3	
Elective/Option Area	3	3
Totals	16	16
Fourth Year		
LA 441, Site Dev and Det III	3	
LA 471, 472, Adv Arch Design I, II	6	6
LA 491, Contemp Issues		2
LA 552, Landscape Planning		2
Electives/Option Area	7	7
Totals	16	17
Fifth Year		
LA 531, Planting Design	4	
Arch 582, Prof Practice	2	
LA 561, Landscape Arch Programming	2	
LA 571, 572, Adv LA Design III, IV	6	8
LA 590, Prof Seminar	2	2
Elective/Option Area		6
Totals	16	16
Curriculum Total		160

Civil Engineering

The mission of the civil engineering department is to provide quality education to prepare nationally competitive undergraduate students for a successful career in civil engineering; to provide advanced skills and knoweledge in state-of-the-art research and design in sub-areas of civil engineering for graduate students; and to provide service to the University, engineering profession, and the public. The departmental objectives are to provide students with:
(a) technical knowledge, design capability, and problem solving skills fundamental to a career in civil engineering,
(b) knowledge and skills necessary for comparative evaluation of design alternatives,
(c) necessary communication skills to successfully practice the civil engineering profession, and
(d) awareness of the need for professionalism, teamwork, life-long learning, and understanding the broader societal implications of civil engineering projects.

Civil engineering includes the planning, design, construction, maintenance, and operation of large and permanent engineering projects of our civilization. Civil engineers are in demand wherever there are people. The major subdivisions of civil engineering are structural, geotechnical, environmental, sanitary, water resources, and transportation engineering.

The civil engineer is responsible for such projects as bridges and large buildings, dams, and other river and harbor work, municipal water supply and sanitation facilities, streets, highways, and other transportation facilities. On many projects, civil engineers work in close cooperation with engineers and scientists from other fields.

The civil engineering program at NDSU is accredited by the Engineering Accrediting Commission of the Accreditation Board for Engineering and Technology (ABET).

The civil engineering curriculum is designed to give students a thorough mathematical and scientific background in all of the subdivisions of the field. At the same time it provides students with an opportunity to place further emphasis on his/her chosen subdivision through technical electives.

Twelve credits of the curriculum are available for technical electives. Students are required to choose three technical electives from the five major areas, while at the same time satisfying the ABET design requirement. All civil engineering students must take a capstone design course, CE 489, which is designed to bring concepts learned in different courses to culminate in a major design experience.

Students interested in structural engineering may choose courses like frame analysis, numerical methods in structural engineering, advanced reinforced concrete, advanced steel design, timber design, plastic design in steel, prestressed concrete, foundation engineering, structural mechanics, and dynamics of structures.

Students interested in water resources, sanitary, or environmental engineering may choose courses like solid waste management, applied hydraulics and hydrology, ground water and seepage, water and wastewater laboratory practices, properties of open channels, air pollution, hazardous waste management, water quality management, and sanitary engineering problems.

Students interested in transportation engineering may choose courses like transportation planning, airport planning and design, railway planning and design, geometric highway design, or traffic engineering and pavement design.

Students interested in geotechnical engineering may choose courses in foundation engineering, earth slopes, and geosynthetics.

The curriculum includes a core of social humanistic subjects to provide the student with a background essential to a proper understanding of the role of engineering in society.

Students in civil engineering are strongly encouraged to participate in the cooperative education program to enhance their classroom education with practical experience in engineering-related positions in industry.

Students transferring into civil engineering from other departments or institutions are encouraged to do so no later than the beginning of the junior year if they wish to complete the degree requirements within two academic years.

Graduate programs leading to the Master of Science degree are available in specialized fields. Refer to the Graduate Bulletin for more specific information.

Recommended Curriculum Civil Engineering

All civil engineering students at NDSU are required to have a minimum cumulative grade-point average of 2.0 and to have received a grade of C or better in Math 165, 166, 228, 259, 266, ME 221, 222, 223, before enrolling in CE 309, 316, 332, and 418.

	Credits	
First Year	**F**	**S**
CE 111, Intro Civil Engr	1	
Chem 121, 121L, 122, 122L Chemistry I, II, Labs	3,1	3,1
CSci 159, CSci Problem Solving		2
Engl 110, 120, College Composition I, II	3	3
Math 165, 166, Calc I, II	4	4
ME 221, Engr Mech I		3
Univ 189, Skills for Academic Success	1	
General Education Elective	3	
Wellness		2
Totals	16	18

Second Year	Credits F	Credits S
CE 204, Surveying	4	
Comm 110, Fund of Public Speaking		3
Engr 311, Impact of Tech I		3
Geol 105, Physical Geology	3	
IME 460, Eval Engr Data		3
Math 228, 259, Linear Alge, Univ Calc III	1,3	
Math 266, Diff Equa		3
ME 212, Graphics and CADD	3	
ME 222, Engr Mech II	3	
ME 223, Mech of Matls		3
Phys 252, University Physics II		4
Totals	17	19
Third Year		
CE 303, Civ Engr Mat		3
CE 309, Fluid Mechanics	3	
CE 316, Soil Mechanics	3	
CE 332, Intro Struct Engr	3	
CE 343, Structural Anal		3
CE 370, Intro Environ Engr		3
CE 371, Environ Engr Lab		1
CE 408, Water Resources and Supply		3
CE 418, Transp Engr		4
ECE 301, Elec Engr I	3	
Engr 312, Impact of Tech II	3	
Engr 402, Prof Ethics	1	
Totals	16	17
Fourth Year		
CE 310, Fluids Lab	1	
CE 404, Reinforced Concrete	3	
CE 444, Steel Design	3	
CE 483, Cont and Spec		3
CE 489, Capstone Design		2
IME 440, Engr Economics		2
ME 350, Ther/Heat Trans	3	
General Education Electives	3	3
Technical Electives	4	8
Totals	17	18
Curriculum Total		138

Technical Electives

Fall:	Credits
CE 410, Water & Wastewater Engineering	3
CE 441/641, Finite Element Analysis	2
CE 446/646, Dynamics of Structures	3
CE 454/654, Geometric Highway Design	3
CE 455/655, Airport Planning & Design	2
CE 456/656, Railroad Planning & Engr	2
CE 461/661, Foundation Engineering	2
CE 472/672, Solid Waste Management	3
CE 477/677, Applied Hydrology	3
CE 478/678, Water Quality Management	3
CE 482, AutoCad	1
CE 720, Continuum Mechanics	3
CE 770, Hazardous Waste Management	3
Spring:	
CE 411/611, Prestressed Concrete	2
CE 417/617, Earth Slopes	2
CE 419/619, Pavement Design	3
CE 421/621, Open Channels	3
CE 430/630, Timber Design	3
CE 445/645, Advanced Steel Design	2
CE 462/662, Designing with Geosynthetics	2
CE 473, 673, Air Pollution	3
CE 479/679, Adv Water & Wastewater Treatment	3
CE 772, Rural Logistics & Distribution Mgmt	3
CE 774, Statewide Transportation Planning	3
CE 776, Ground Water & Seepage	3
CE 781, Traffic Engineering	3
CE 778, Transportation Administration	3

Construction Management and Engineering

The mission of the Division of Construction Managment and Engineering at North Dakota State University is to provide quality programs for preparing nationally competitive undergraduate and graduate students for a successful careeer in construction. The programs are designed to provide education, research, and outreach opportunities that serve both the needs of students and those of the construction industry.

The educational objectives of the programs are to provide students with:
(a) basic skills necessary to plan, organize, and control resources to manage the overall construction process,
(b) technical knowledge, design, and problem solving skills for a career in construction,
(c) knowledge and skills necessary to identify, define, and compare design alternatives,
(d) necessary communication skills for successful practice of the construction profession, and
(e) opportunities to learn the need for professionalism and life-long learning and the need to understand the broader societal implications of construction projects.

The continued rapid growth of the construction industry demands new kinds of professionals, the construction engineer and manager. These professional constructors will be required to integrate new and high level technology into all aspects of the design and construction process.

All the aspects that contribute to the finished construction project—from the initial planning stage through the final project turnover—require close and careful attention. An individual with management and technical ability to oversee an entire project is essential to the industry.

To fill the need for qualified professionals, Bachelor of Science degree programs in Construction Management and Construction Engineering are offered.

The construction programs are very practical in nature and are designed to prepare the graduate for entry into the construction industry on a professional level. Construction graduates build homes, highways, bridges, power plants, dams, tunnels, skyscrapers, and many other facilities of benefit to society.

Construction Engineering

The construction engineering program is a blend of engineering, construction, business, and management courses. This program is designed for those who want to work in the construction industry and enjoy the status of a professional engineer. It is somewhat similar to the construction management program, but has more emphasis on engineering and technical courses. The construction engineering program is accredited by the Accreditation Board for Engineering and Technology.

Recommended Curriculum Construction Engineering

First Year	Credits F	Credits S
Chem 121, 121L, Gen Chem I, Lab	3,1	
CM&E 111, Intro to CM&E	1	
Econ 201, Prin of Microeconomics	3	
Engl 110, 120, College Composition I, II	3	3
Math 165, 166, Calc I, II	4	4
ME 212, Graphics and CADD		3
ME 221, Engr Mech I		3
Psyc 111, Intro Psychology		3
Univ 189, Skills for Academic Success	1	
Wellness	2	
Totals	18	16
Second Year		
CE 204, Surveying	4	
CM&E 385, Const Safety		2
Comm 110, Fund of Public Speaking		3
Geol 105, Physical Geol	3	
Math 228/259, Intro to Linear Algebra/Calc III	3,1	
Math 266, Diff Eqn		3
ME 222, Engr Mech II	3	
ME 223, Mech of Matls		3
Phys 251, 252, University Physics I, II	5	4
Humanities/Cultural Diversity Elective		3
Totals	19	18
Third Year		
CE 303, Materials		3
CE 309, Fluid Mechanics	3	
CE 316, Soil Mechanics	3	
CE 332, Intro Struc Engr	3	
CE 343, Structural Analysis		3
CM&E 301, Const Tech & Equip		4
CM&E 310, Quality Contr		2
CM&E 315, Specs and Contracts	3	
CM&E 370, Intro Cost Estimating	2	
CM&E 411, Const Cost Estimating		2
IME 440, Engr Econ		2
Stat 330, Intro Statistics	3	
Totals	17	16

Fourth Year	Credits F	Credits S
Busn 431, Busn Law I		3
CE 404, Reinf Concrete	3	
CE 430, Timber Design		3
CE 444, Steel Design	3	
CM&E 403, Sched & Proj Control	4	
CM&E 409, Highway Const		2
CM&E 412, Const Mgt		3
CM&E 489, Const Design		3
ECE 301, Elec Engr I	3	
Engr 311, Tech and Soc I	3	
Engr 402, Prof Ethics		1
IME 455, Mgt People System	2	
Technical Elective		3
Totals	18	18
Curriculum Total		140

Construction Management

Construction management is a combination of engineering technology, construction techniques, and management to meet the needs of the rapidly growing construction industry. The program is designed to prepare students for the art of achieving maximum profit by efficient use of people, machines, materials, and money to complete a construction project on time and to the satisfaction of the owner.

A meld of engineering, construction, management, and business gives the student a background and understanding of management's point of view in the construction industry. The construction management program is accredited by the American Council for Construction Education.

Recommended Curriculum Construction Management

First Year	Credits F	Credits S
Chem 121, 121L, Gen Chemistry I, Lab	3,1	
CM&E 111, Intro to CM&E	1	
Comm 110, Fund of Public Speaking		3
Engl 110, 120, College Composition I, II	3	3
Math 165, Calculus I	4	
ME 212, Engr Graph CADD		3
Phys 211, 212, College Physics I, II	3	3
Univ 189, Skills for Academic Success	1	
Humanities/Cultural Diversity Elective		3
Wellness		2
Totals	16	17
Second Year		
Acct 102, Fundamentals of Acct		3
CE 204, Surveying	4	
CM&E 205, Building Const		3
CM&E 325, Fluid Mechanics for Tech		3
CM&E 385, Const Safety		2
Econ 201, Prin of Micro	3	
Engr 311, Imp of Tech I	3	
Geol 105, Physical Geol	3	
ME 221, Engr Mechanics I	3	
ME 223, Mechanics of Materials		3
Psyc 111, Intro to Psyc		3
Totals	16	17
Third Year		
Busn 350, 351, Prin Mgt, Org Behav	3	3
Busn 431, Busn Law I		3
CE 303, Materials		3
CM&E 301, Const Tech & Equip		4
CM&E 310, Quality Control		2
CM&E 315, Specs and Contracts	3	
CM&E 320, Soils and Found	4	
CM&E 370, Intro to Cost Estimating	2	
CM&E 411, Const Cost Estimating		2
IME 440, Engr Economy	2	
Stat 330, Intro Statistics	3	
Totals	17	17
Fourth Year		
CM&E 403, Sched & Proj Control	4	
CM&E 412, Const Mgt		3
CM&E 413, Const Spec Res		2
CM&E 420, Labor Productivity		3
CM&E 421, Mech and Elec Equ	3	
CM&E 430, Land Development	3	
CM&E 450, Steel Design	3	
CM&E 453, Conc Design Const		3
Busn Elective		3
Technical Elective	3	
Totals	16	14
Curriculum Total		130

Electrical and Computer Engineering

The mission of the Department of Electrical and Computer Engineering is to provide quality educational opportunities for undergraduate and graduate students through teaching, research, and professional service and to provide specialized support to the greater community. Departmental objectives:
1. Prepare electrical and computer engineering students to become competent engineers.
2. Promote life-long learning practice through continuous curriculum review, research, design, and other scholarly activities.
3. Stimulate student and faculty professional development through publications, participation in professional meetings and societies, and research involvement.
4. Maintain and enhance a positive departmental environment conducive to teamwork, discovery, and professional development.
5. Promote public awareness, interest, and respect for science, engineering, and technology.
6. Provide specialized services to the region, industrial partners, and the professional community.

Electrical and computer engineers create products and services for society out of materials that exist in nature by using principles of science and creativity. The profession is broad, encompassing products valued by society in many technical specialties from electric power and energy utilization to those for current and future information transmission. Career employment opportunities within the profession range over design, development, manufacturing, sales, management, teaching, and research for industry and government.

Selective Admission

Departmental admission requirements for freshmen are an ACT (or equivalent) math test score of 23, or a top 30 percent class standing with a math ACT of 20. Transfer students from U.S. institutions must have a 2.3 GPA; international students a 3.0 GPA.

Further, the department policy is that transfer credits with grades of D in mathematics, science, or engineering courses are not accepted for the electrical and computer engineering curriculums.

Prior to registration in junior- and senior-level courses, majors must have a grade of "C" or better in the following courses: all required mathematics courses through 265; ECE 111, 173, 275, and EE 206. Further, an overall GPA of 2.0 or above is required.

The Programs

Major components of the undergraduate programs are basic science and mathematics, humanities and social sciences, communication, engineering science, engineering design and ethics, and both breadth and depth in electrical and computer engineering.

Graduate studies leading to the Master of Science degree are offered in the department. The Doctor of Philosophy degree in engineering is available through the college with specialization in electrical and computer engineering. Refer to the Graduate Bulletin for details.

Computer Engineering Program

The computer engineering program provides a background in three broad areas: computer hardware, software, and hardware-software integration. Fundamental computer topics included in the program are microprocessors, embedded systems, computer architecture, digital systems, data communications and other related computing material. In addition, the program includes core engineering subjects that are common to all engineering disciplines and basic university studies in humanities and social science.

Recommended Curriculum Computer Engineering

First Year	Credits F	Credits S
Chem 121, General Chemistry	3	
Comm 110, Fund of Public Speaking	3	
ECE 111, Introduction to Electrical Engr	3	
ECE 275, Digital Systems I		3
Engl 110, 120 College Composition I, II	3	3
Math 165, 166 Calculus I, II	4	4
Phys 251, University Physics I		5
Univ 189, Skills for Academic Success	1	
Wellness		2
Totals	17	17
Second Year		
ECE 173, Intro to Computing	3	
EE 206, Circuit Analysis I		4
Math 229, Basic Linear Algebra	2	
Math 265, 266 Calculus III, Diff Eq	4	3
CSci 161, Computer Science II		4
ME 221, Engr Mechanics I	3	
Phys 252, University Physics II	4	
Physical Science Lab	1	
Social Science Elective		3
CSci 222 Discrete Math		3
Totals	17	17
Third Year		
ECE 311, Circuit Analysis II	3	
ECE 312, Dig/Analog Circuits Lab	1	
ECE 314, Electromag Signals Lab		1
ECE 321, Electronics I	3	
ECE 322, Electronics I Lab	1	
ECE 324, Electronics II Lab		1
ECE 343, Signals and Systems		3
ECE 351, Applied Electromagnetics	3	
ECE 374, Computer Organization		3
ECE 376, Embedded Systems	3	
ECE 441, Random Processes		3
ECE 470, Digital Systems II		3
Humanities, Social Science Electives	3	3
Totals	17	17
Fourth Year		
ECE 401, 403 Design I, II	3	3
ECE 404, Communications/DSP Lab	1	
ECE 423, Digital Electronics		3
ECE 443, Communications I	3	
ECE 373, Assembly Programming	3	
CSci 474, Operating System Concepts	3	
Engr 402, Ethics and Social Resp		1
ECE Electives	3	3
Engr Science Electives		3
Humanities Electives		3
Totals	16	16
Curriculum Totals		134

Students must meet the University's general education requirements as well as the curriculum requirements in effect at the time of entrance into a program.

Electives

The sample curriculum contains student choices (electives) of the following type: humanities/social sciences; engineering science; and ECE electives.

The following are recommended electives for students interested in the computer engineering technical specialty of electrical and computer engineering.

Engineering Science Electives (6-9 credits)

CSci 366, Files for Database Systems 3
CSci 372, Comparative Languages 3
CSci 426, Introduction to Artificial Intelligence 3
CSci 458, Microcomputer Graphics 3
CSci 459, Local Area Networks 3
CSci 467, Algorithm Analysis 3
CSci 475, Operating Systems Design 3
CSci 477, Object-Oriented Systems 3

ECE Electives (9-12 credits)

ECE 323, Electronics II 3
ECE 331, Energy Conversion 3
ECE 375, Digital System Design & Implementation . 3
ECE 411, Optics for Engineers & Scientists 3
ECE 421, Communication Circuits 3
ECE 425, Introduction to Semi-Conductor Devices . 3
ECE 431, Power Systems 3
ECE 433, Power Systems Design 3
ECE 437, Power Electronics 3
ECE 445, Communications II 3
ECE 453, Signal Integrity 3
ECE 455, Designing for Electromagnetic Compatability 3
ECE 457, Optical Signal Transmission 3
ECE 461, Control Systems 3
ECE 463, Digital Control 3
ECE 471, Computer Systems Design & Implementation 3
ECE 483, Instrumentation for Engineers 3
ECE 485, Biomedical Engineering 3
ECE 487, Cardiovascular Engineering 3
ECE 496, Field Experience 3

There are also fact sheets covering other specialty areas in electrical and computer engineering.

Electrical Engineering Program

The electrical engineering program at NDSU is accredited by the Engineering Accrediting Commission of the Accreditation Board for Engineering and Technology (ABET).

EE Specialization

The electrical engineering curriculum is designed to reflect the broad nature of the field, and students may tailor their studies within broad parameters. Students are encouraged to develop an individual program of study in close consultation with their advisers. Examples are available to illustrate how specialization may be obtained in a number of different technical areas. Students may mix and match from the examples to suit their particular interests. Technical areas include the following:

Biomedical Engineering: This area is firmly based in engineering and the life sciences. The integration of medicine and engineering serves to provide appropriate products, tools, and techniques for research diagnosis and treatment by health care professionals. Some important products are artificial hearts, medical imaging (MRI, ultrasound, CT scans), prosthetic devices, and computer aids to diagnosis. Biomedical engineers help identify the problems and needs that can be solved using engineering technology and systems methodology to provide high-quality health care at reasonable cost.

Communication and Signal Processing: These are closely related fields within electrical engineering. Communication is the process of transferring information from one point in time and space to another point. Signal processing involves signal representation, as well as signal design and filtering. Students with this specialization find challenging opportunities worldwide to meet the need for more convenient, inexpensive, and reliable communication and signal processing.

Control Engineering: This is the design and implementation of algorithms for controlling physical systems. Examples include active suspension for cars, auto pilots for aircraft, and robot motion control.

Electromagnetics: This area includes electromagnetic compatibility, fiber optics, antennas, microwave devices, radar, sonar, satellite systems, power and communication transmission lines, grounding, shielding, and propagation.

Electronics and Microelectronics: Examples are integrated circuits, VLSI, transistors, lasers, consumer electronics, defense electronics, power electronics, and electronic materials.

Optical Engineering: The optical engineering option was developed jointly with the Department of Physics. Many technical disciplines now use optics. Medicine uses laser surgery and optical diagnostics. Communications is expanding optical fiber communication. Image processing is using optical techniques. The optical engineering option prepares future engineers in such areas as quantum theory; coherent/incoherent, polarized/non-polarized light; geometric, physical and Fourier optics; holography; and image processing and acquisition.

Power Systems: This area includes the generation, transmission, distribution, and utilization of electric energy subject to safety, environmental, and economic concerns.

Recommended Curriculum Electrical Engineering

	Credits F	S
First Year		
Chem 121, General Chem	3	
Comm 110, Fund of Public Speaking	3	
ECE 111, Intro to Electrical Engr	3	
ECE 275, Digital Systems I		3
Engl 110, 120, College Composition I, II	3	3
Math 165, 166, Calculus I, II	4	4
Phys 251, University Physics I		5
Univ 189, Skills for Academic Success	1	
Wellness		2
Totals	17	17
Second Year		
ECE 173, Intro to Computing	3	
EE 206, Circuit Analysis I		4
Math 229, Basic Linear Algebra	2	
Math 265, 266, Calc III, Diff Eq	4	3
ME 221, Engr Mechanics I	3	
Phys 252, University Physics II	4	
Physical Science Lab	1	
Engr Sci Elective		3-4
Social Science Electives		3
Math/Science Elective		3-4
Totals	17	16-18
Third Year		
ECE 311, Circuit Analysis II	3	
ECE 312, Dig/Analog Circuits Lab	1	
ECE 314, Signals, Electromag Lab		1
ECE 321, 323, Electronics I, II	3	3
ECE 322, 324, Electronics Lab I & II	1	1
ECE 331, Energy Conversion		3
ECE 343, Signals and Systems		3
ECE 351, Applied Electromagnetics	3	
ECE 376, Embedded Systems	3	
ECE 441, Random Processes		3
Humanities, Soc Sci Electives	3	3
Totals	17	17
Fourth Year		
ECE 401, 403, Design I, II	3	3
ECE 402, Control Systems & Machines Lab	1	
ECE 443, Communications I	3	
ECE 461, Control Systems	3	
Engr 402, Ethics and Soc Resp		1
ECE Electives	3	6
ECE or Engr Science Elective	2-3	
Engr Sci Elective		3
Humanities, Soc Sci Elective		3
Totals	15-16	16
Curriculum Total		132-135

EE Curriculum Electives

The EE curriculum includes elective courses of the following types: humanities, social/ behavioral sciences, math/ science, engineering science, and ECE electives.

Engineering Science Electives	Credits
CE 309, 310, Fluid Mechanics, Lab	3,1
CSci 161, Comp Science II	4
CSci 366, Files for Database Sys	3
CSci 372, Comparative Prog Lang	3
CSci 426, Intro to Artificial Intelligence	3
CSci 458, Microcomputer Graphics	3
CSci 459, Local Area Networks	3
CSci 467, Algorithm Analysis	3
CSci 474, Operating Systems Concepts	3
CSci 475, Operating Systems Design	3
CSci 477, Obj Oriented Sys	3
IME 440, Engineering Economy	2-3
IME 456, Prog and Proj Mgt	3
IME 461, Quality Assur and Control	3
ME 222, Engr Mechanics II	3
ME 223, Mechanics of Materials	3
ME 350, Thermodynamics/Heat	3
ME 411, Nuclear Engineering	3
Math/Science Electives	
Biol 150, General Biology	3
Chem 122, General Chemistry II	3
Chem 341, Organic Chemistry I	3
Chem 364, Physical Chemistry I	4
CSci 222, Discrete Mathematics	3
CSci 235, 236, Theoretical Comp Sci I, II	3,3
Math 270, Intro to Abstract Math	3
Math 329, Linear Algebra	3
Math 420, 421, Abstract Algebra I, II	3,3
Math 450, 451, Real Analysis I, II	3,3
Math 452, Complex Analysis	3
Math 480, Applied Dif Eq	3
Math 481, Fourier Analysis	3
Math 483, Partial Dif Eq	3

	Credits
Math 488, 489, Numerical Analysis I, II	3,3
Phys 350, Modern Physics	3
Phys 401, Fund Prop of Solids	3
Phys 402, Optical Electronics	3
Phys 485, Modern Physics I	3
Zoo 170, General Zoology	3

ECE Electives

ECE 375, Dig Sys Design and Implem	3
ECE 373, Assembly Lang/CPU Arch.	3
ECE 374, Computer Organization.	3
ECE 404, Advanced EE Laboratory	1
ECE 411, Optics for Engineers & Scientists	3
ECE 421, Communication Circuits	3
ECE 423, Digital Electronics	3
ECE 425, Intro to Semi-Cond, Devices	3
ECE 431, Power Systems.	3
ECE 433, Power Systems Design	3
ECE 437, Power Electronics	3
ECE 445, Communications II	3
ECE 453, Signal Integrity	3
ECE 455, Electromagnetic Compatibility	3
ECE 457, Optical Signal Transmission	3
ECE 463, Digital Control.	3
ECE 470, Digital Systems II	3
ECE 471, Comp Sys Des and Implem	3
ECE 483, Instrumentation for Engineers	3
ECE 485, Biomedical Engineering	3
ECE 487, Cardiovascular Engineering	3
ECE 496, Field Experience.	3

For students interested in pursuing one of the areas of specialization, lists of recommendations are available from the ECE Department.

Cooperative Education Program

The Cooperative Education Program allows students to alternate classroom study with a series of paid professional work experiences related to electrical and computer engineering. These experiences increase in complexity as the student's background increases.

The program provides opportunity for pre-graduation experience in the profession, exploration of several career opportunities, money for education, an enriched degree, and enhanced opportunities for employment following graduation.

Industrial and Manufacturing Engineering

Two majors are offered within the Industrial and Manufacturing Engineering Department (IME): Industrial Engineering and Management (IE&M) and Manufacturing Engineering (MfgE). Both programs are professionally accredited through the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Career positions for graduates of the two programs often have some similarity; so, many of the courses required for the two majors are the same. One of the simple ways to distinguish between IE&M and MfgE is to note that industrial engineering and management applies engineering thinking to all manner of commercial and industrial enterprises, while everything that a manufacturing engineer does relates in some way to the production of goods. Following the differing ways that graduates are employed in career positions, the two IME programs are differentiated by specific courses that address particular needs of the respective career tracks. IE&M students take additional courses in systems engineering and in the application of engineering skills in people management. MfgE students take additional courses in process engineering and production engineering.

In addition, both majors offer the student opportunities for a small amount of specialization in the junior and senior years. IE&M students can apply their elective courses to extra study in production operations and management, healthcare management engineering, and reliability and quality management. MfgE students can elect additional specialization in aircraft manufacturing, electronics manufacturing and process engineering.

Both IE&M and MfgE students learn in an environment of professional realism. Many of the major courses fulfill their learning objectives through projects that are done with industrial companies. Students interact with practicing professionals to learn the real-world applications of the theories they master in the classrooms. There also are many laboratories where students gain hands-on understanding of machinery and engineering systems. Students in both IME majors are urged to take advantage of cooperative education and internship positions wherever possible. The knowledge gained through these experiences enhances career preparation and provides for expanded placement opportunity upon graduation.

Learning in the IME department is a partnership of student and faculty. The student's responsibility is to learn — to master the concepts, theories and practices that lead to career success. The faculty responsibility is four-fold: to provide an atmosphere that is conducive to learning, to assure availability of the tools necessary for effective and efficient learning, to offer guidance on educational and professional matters, and to evaluate student achievement. The usual faculty role is one of mentor, encouraging students to grow in stature as soon-to-be engineers and as human beings.

IME graduates are prepared for careers that design, develop and implement devices, processes and systems that manufacture, construct, operate and service products, equipment and facilities that are often conceived in other engineering disciplines. These career positions form the vital linkages between abstract concepts and the reality of products and facilities of real use to customers. Graduates are in demand for employment in a very wide range of industries from production of all types of goods to transportation and distribution to information to healthcare to consulting.

In all cases, career positions for IME graduates involve design of processes and procedures in advanced technology environments. These professions routinely apply sophisticated modern tools in information handling, distributed communications, computer-driven controls, and a wide variety of technologically advanced equipment and apparatus. In addition, IME career professionals are skilled in the integration of people and technology within the business context of world-class enterprises. They make satisfying careers in organizations of all sizes and types, located in all parts of the world. Graduates generally have wide choice in where they want to work and live, and what size and kind of company they want to work for.

Post-graduate studies also are available in the IME department, leading to the Master of Science and Doctor of Philosophy degrees. Please see the NDSU Graduate Bulletin for details.

Industrial Engineering and Management Major

Industrial engineering and management is a good choice for people with the aptitude and interest for careers that blend technology and people. First, this is an engineering program, with the traditional content of mathematics, sciences, engineering analysis and synthesis. Graduates are well positioned for success in nationally-normed professional engineering examinations. Beyond the basics, this program also challenges students to integrate resources with technology. In addition to scientific principles and technological systems, IE&M students study people systems, cost analysis, facilities and other elements of the business enterprise. The "engineering" and "management" pieces are blended and integrated.

Just as the profession requires a blend of scientific, technological and humanistic skills, student learning in IE&M is an integrated process. The discipline-specific courses place the student in position to experience many elements of real situations in industry and commerce. Moreover, the program has been nationally cited for integrating design across all levels, with freshmen and juniors or sophomores and seniors often working together.

Graduates are in high demand across a wide spectrum of industries. In recent years, the very active employers have represented transportation, warehousing and distribution, healthcare, information systems, software, facilities development and consulting industries, as well as many of the production sectors that have been the traditional concentration for industrial engineers. IE&M graduates are sought after for responsible positions in project and organizational management, financial modeling, technological training, logistics, and design of processes, procedures, facilities and systems.

Recommended Curriculum Industrial Engineering and Management

	Credits F	S
First Year		
Engl 110, College Composition	3	
Univ 189, Skills for Academic Success	1	
Wellness Elective		2
Math 165, 166, Calculus I, II	4	4
Chem 121, 122, General Chemistry I. II	3	3
Chem 121L, 122L, General Chem Lab I, II	1	1
IME 111, Intro to Ind & Mfg Engr	1	
IME 112, Computer/Software Appli in Engr		2
ECE 173, Intro to Computers	3	
ME 212, Engineering Graphics		3
ME 221, Engineering Mechanics I		3
Totals	16	18
Second Year		
Engl 120, College Composition II	3	
Comm 110, Fund of Public Speaking		3
Gen Ed Elective	3	
Math 229, Basic Linear Algebra	2	
Math 265, Calculus III	4	
Math 266, Intro to Differential Equations		3
Phys 252, University Physics II		4
Phys 252L, University Physics Lab II		1
IME 310, Survey of Ind & Sys Engr Applic	3	
IME 311, Work/Station Design		3
ME 222, Engineering Mechanics II	3	
ME 223, Mechanics of Materials		3
Totals	18	17
Third Year		
Gen Ed Elective	3	
IME 330, Manufacturing Processes	3	
IME 440, Engineering Economics	3	
IME 450, Systems Engineering & Mgmt	2	
IME 460, Evaluation of Engineering Data	3	
IME 461, Quality Assurance & Control		3
IME 470, Operations Research		3
IME 472, Simulation of Bus & Ind Systems		3
ECE 301, 303, Electrical Engineering I, II	3	3
ECE 306, Electrical Engineering Lab		1
ME 350, Thermodynamics		3
Totals	17	16
Fourth Year		
Gen Ed Elective	3	3
Engr 402, Engineering Ethics		1
IME 452, Integrated Ind Information Systems.		3
IME 455, Management of People Systems.	2	
IME 456, Program & Project Management		3
IME 480, Production & Inventory Control	3	
IME 482, Automated Mfg Systems	3	
IME 485, Ind & Mfg Facilities Design		3
CE 309, Fluid Mechanics	3	
Approved Technical Electives	3	3
Totals	17	16
Curriculum Total		135

Industrial Engineering and Management Minor

Students majoring in any engineering discipline may elect a minor in Industrial Engineering and Management. These optional studies offer engineering students the opportunity to add important career-enhancing skills to their technological competencies. The elected courses in an IE&M minor add skills for integrating technology and resources within the complex of people, technology, machinery and information that make up the successful modern business enterprise. Students completing this minor will achieve better understanding of organizational and management processes and will be better prepared to work in the multi-functional teams crucial to success in industry.

Minors at NDSU require a minimum of 16 credits. The foundation requirements for the IE&M minor are Survey of Industrial Systems Applications (IME 310) and Work/Station Design and Measurement (IME 311). The remaining 10 credits may be selected from any IME 300- and 400-level courses for which prerequisites are in place. The only exception is Evaluation of Engineering Data (IME 460), which does not count toward this minor.

Students must complete the graduation requirements for another engineering major before the designation of the IE&M minor will be placed on their transcripts.

Management Sequence for Non-Majors

The practices and procedures learned in the Industrial Engineering and Management major are universally applied in public and private organizations of all kinds. IE&M courses are available as electives for students majoring in computer science, mathematics, sciences, business administration, cereal science, agricultural economics and facility management. Courses recommended for non-majors are IME 310, 311, 440, 452, 453, 455, 456 and 462.

Industrial Engineering and Management Options

Students majoring in industrial engineering and management may prepare for specific career choices by careful use of the technical electives included in the IE&M major. It is suggested that students confer with their academic adviser for assistance in choosing the most appropriate optional courses. Particular areas of emphasis may be selected in the following special interests:

Healthcare management engineering
Production operations and management
Process and production engineering
Reliability and quality management
Specialized manufacturing processes (electronics, aircraft, plastics and composites)

These topical areas also are available for post-graduate study, leading to degrees of Master of Science and Doctor of Philosophy. Please refer to the NDSU Graduate Bulletin for details.

Manufacturing Engineering Major

Manufacturing engineering is a good choice for people who have both aptitude and interest in production of goods for improved living standard for the general populace. This career field is all about the production of goods — from automobiles and tractors and airplanes to electronic products to recreational products, sports equipment and toys to foodstuffs. Manufacturing engineers are employed in every industry that produces goods of some kind.

Manufacturing engineers may focus on the interaction between workpiece and tool as process scientists or process engineers. They may concentrate on integrating the many different processes and parts necessary to make up finished products — as production engineers. Or, as manufacturing systems engineers, they may take a very wide view of the manufacturing enterprise, including its supply chain, distribution channels, financial structure and resource management. In every particular focus, manufacturing engineers are the people who design the processes through which products are made with the required functionality, to high quality standards, in the quantities needed, available when and where customers prefer, and at the best possible price.

Every day, manufacturing engineers make decisions about technology, machinery, people, and money. The preparation for the excitement and challenge of modern manufacturing requires students to master the mathematics and applied science common to all engineering disciplines. They then will master the fundamentals of process engineering and production engineering so that they may apply these principles to production of any type of goods.

At graduation, MfgE students are well positioned to select career employment in any manufacturing industry. Graduates are actively recruited by companies that produce agricultural and construction machinery and vehicles, complex industrial apparatus, recreational vehicles, airplanes, household goods, building products, and both industrial and consumer electronics. MfgE graduates generally begin their careers designing processes and production systems or directly managing some phase of manufacturing. Frequently, they progress to increased responsibilities, with broader scope and yet more opportunity.

Recommended Curriculum for Manufacturing Engineering

	Credits F	S
First Year		
Engl 110, 120, College Composition I, II	3	3
Univ 189, Skills for Academic Success	1	
Math 165, 166, Calculus I, II	4	4
Chem 121, 122, Gen Chemistry I. II	3	3
Chem 121L, 122L, Gen Chemistry Lab I, II	1	1
IME 111, Intro to Ind & Mfg Engineering	1	
ECE 173, Introduction to Computers	3	
ME 212, Engineering Graphics		3
ME 221, Engineering Mechanics I		3
Totals	16	17
Second Year		
Gen Ed Elective	3	
Math 229; Basic Linear Algebra	2	
Math 259; University Calculus III	3	
Math 266; Intro to Differential Equations		3
Phys 252; University Physics II		4
Phys 252L; University Physics Lab II		1

	Credits F	S
IME 311, Work/Station Design		3
IME 330, Manufacturing Processes	3	
IME 380, CAD/CAM for Manufacturing	3	
ME 222, Engineering Mechanics II	3	
ME 223, Mechanics of Materials		3
ME 331, Engineering Materials		4
Totals	17	18
Third Year		
Gen Ed Electives	3	3
Wellness Elective		2
Comm 110, Fund of Public Speaking		3
IME 430, Process Engineering	3	
IME 432, Composite Materials Mfg		3
IME 440, Engineering Economics		3
IME 460, Evaluation of Engineering Data	3	
ECE 301, Electrical Engineering I	3	
Approved Technical Electives	3	3
Totals	15	17
Fourth Year		
Gen Ed Elective	3	
Engr 402, Engineering Ethics	1	
IME 431, Production Engineering		3
IME 461, Quality Assurance & Control		3
IME 480, Production & Inventory Control	3	
IME 482, Automated Mfg Systems	3	
IME 489, Mfg Engineering Capstone		3
ME 350, Thermodynamics	3	
Approved Technical Electives	3	6
Totals	16	15
Curriculum Total		131

Manufacturing Sequences for Non-Majors

Most industrial enterprises engage in the production of some sort of goods in some way and to some degree. Students majoring in other disciplines can enhance their career value by expanding their knowledge of process engineering and production engineering.

For students majoring in other engineering disciplines or in the agricultural or physical sciences, the technological foundations of manufacturing can be acquired through Manufacturing Processes (IME 330), Process Engineering (IME 430) and Production Engineering (IME 431). Engineering majors from other disciplines may elect to acquire more depth in aircraft manufacturing (IME 420, 422), electronics manufacturing (IME 427) and plastics and composite manufacturing (IME 432, 435).

Manufacturing Engineering Options

Students majoring in manufacturing engineering may prepare for specific career choices by careful use of the four technical electives included in the MfgE major. It is suggested that students confer with their academic adviser for assistance in choosing the most appropriate optional courses. The MfgE major requires that students select 12 credits of approved elective courses, and these may be selected in the following special interests:

- Electronics manufacturing
- Aircraft manufacturing
- Process engineering
- Production and manufacturing systems engineering

These topical areas also are available for post-graduate study, leading to degrees of Master of Science and Doctor of Philosophy. Please refer to the NDSU Graduate Bulletin for details.

Mechanical Engineering

Mechanical engineering is a broad field primarily concerned with the principles of motion, energy, and force. Mechanical engineers are called upon to design machinery, mechanisms, and systems that function safely, reliably, and efficiently to serve needs of society. To accomplish this, mechanical engineers apply scientific principles to problems that involve the motion of heat, gases, fluids, and solid materials.

Mechanical engineers may be found in nearly all segments of society. They work in industry, consulting practices, government facilities, and universities. In industry, mechanical engineers work for equipment manufacturers, utilities, material processing plants, environmental firms, and companies that deal with aerospace, transportation, petroleum, biomedical products, and others. Mechanical engineers employed by the government and universities contribute to the betterment of society by conducting research to solve present and future problems. As technology becomes more prevalent in daily life, mechanical engineers are increasingly called upon to apply that technology to develop devices that improve the standard of living.

The goal of the mechanical engineering curriculum at NDSU is to produce baccalaureate-level graduates who are well prepared to accept engineering positions in industry and government or to pursue advanced degree studies. Our mission is to educate undergraduate and graduate students in the fundamentals of the discipline and to prepare graduates who effectively function in society in the field of their choice while also having the learning skills to adapt to evolving personal and professional goals. To accomplish this mission, the educational program objectives are the following:

1. Graduates must possess a fundamental understanding of the basic engineering sciences in the three core areas of the curriculum: mechanical sciences, thermal/fluid sciences, and materials sciences.
2. Graduates must possess the ability to apply fundamental concepts and utilize modern engineering tools in the analysis, design, and testing of components, systems, or processes relevant to the field of mechanical engineering.
3. Graduates must have the ability to work in a team environment and effectively communicate their ideas and designs in a manner that is consistent with the technical expertise of their audience.
4. Graduates must possess a broad background in the humanities and social sciences and understand the context in which their designs will be implemented along with the corresponding impact on society, both locally and globally.

Strong program emphasis is placed on engineering science, laboratory, and design. The use of modern computer tools and techniques in engineering practice is also incorporated throughout the curriculum. In addition, liberal arts education is included to prepare graduates for becoming concerned and productive members of society.

Students transferring into mechanical engineering from other departments or institutions are encouraged to do so no later than the beginning of the junior year if they wish to complete the degree requirements within two academic years.

No course grade less than a “C” will be accepted to fulfill a program requirement.

Graduate programs leading to the Master of Science degree are offered by the department. The Doctor of Philosophy degree in engineering is available through the college with specialization in mechanical engineering. Refer to the Graduate Bulletin for more specific information.

Curriculum Options

Mechanical engineering majors may choose one of four options to complete their program of study.

All mechanical engineering majors have a common curriculum during the first two years. At the beginning of the third year, students choose one of the following curriculum options.

Standard: Students who are interested in exploring a spectrum of technical electives may follow the standard curriculum and choose a minimum of two technical elective courses. These courses cover a wide range of topics and students may tailor their choices to reflect their special interests.

Injection Molding: This curriculum option provides students with an opportunity to acquire a working knowledge of plastics and plastics processing with an emphasis on injection molding technology.

Polymers and Coatings: This option is for students wishing to prepare for a career as a mechanical engineer in the plastics and coatings industries, or for a career in a manufacturing industry as a mechanical engineer with expertise in the fields of plastics and coatings. The polymers and coatings option in mechanical engineering at NDSU is a unique program offered nowhere else in the United States.

Numerous career opportunities for mechanical engineers with this specialized training are available in the coatings industry, which manufactures paints and coatings to enhance and preserve such items as automobiles, ships, steel structures, machines, and household appliances. Many other opportunities are available in various manufacturing industries where more and more components previously fabricated from metals are now made from plastics and fiber-reinforced composite materials.

Due to the unique nature of this program, the demand for graduates far exceeds the supply.

Power: The power option curriculum is designed to prepare the student for a career in the broad field of energy production. In addition to a well-rounded background in mechanical engineering design, the student receives a thorough education in power plant design and in those areas of electrical engineering that are related to the production of electrical energy. There is a need for mechanical engineers with this particular background and training for careers in the electrical power production and coal gasification industries in North Dakota and surrounding states. Electromechanical equipment manufacturers and consulting engineering firms also have a great demand for graduates who complete the power option curriculum.

Cooperative Education

Students in mechanical engineering may participate in the Cooperative Education program at NDSU starting in their sophomore year. Students gain valuable industrial experience to complement their academic studies. Internships may last from one to three semesters.

Wages and benefits for co-op students are determined by the employer and are influenced by such factors as established wage scales, the co-op student's responsibilities, and the nature of the employer's business.

Aviation Program

A program of flight training is available, which prepares students for the FAA examinations for the Private Pilot's License. Three courses are offered under this program: ME 311 Introduction to Aviation, ME 312 Introduction to Flight, and ME 313 Commercial Instrument Ground School.

Any student enrolled at NDSU or one of the other two Tri-College institutions may enroll in this program. No other courses are required as prerequisites.

Recommended Curriculum Mechanical Engineering

All Options	**Credits**	
First Year	**F**	**S**
Chem 121, 122, Gen Chem I, II	3	3
Engl 110, 120, College Composition I, II	3	3
Math 165, 166, Calculus I, II	4	4
ME 189, Skills for Academic Success	1	
ME 221, Engr Mechanics I		3
Humanities/Soc Sci Electives	6	3
Wellness		2
Totals	17	18
Second Year		
Comm 110, Fund of Public Speaking		3
IME 330, Process Engineering	2	
Math 229, 259, Basic Lin Alg/Univ Calc III	2,3	
Math 266, Intro Diff Equations		3
ME 212, Fund of Visual Communication	3	
ME 213, Modeling Engr Systems		3
ME 222, Engr Mechanics II	3	
ME 223, Mech of Materials	3	
ME 351, Thermodynamics I		3
Phys 252, 252L, Univ Physics II, Lab		4,1
Humanities, Soc Sci Elec (for P&C option)	3	
Totals	19	17

Standard Option	**Credits**	
Third Year	**F**	**S**
ECE 301, 303, 306, Elec Engr I, II, Lab	3	3,1
Engr 320, Technical Communication	3	
IME 460, Eval of Engr Data		3
ME 331, 332, Engr Materials I, II	4	3
ME 341, Mech of Machinery	3	
ME 352, Fluid Dynamics	3	
ME 353, Thermodynamics II		3
ME 423, Intermediate Mechanics of Materials		3
ME 455, Mech Systems Lab I		1
Totals	16	17
Fourth Year		
Engr 402, Prof Ethics	1	
IME 440, Engr Economy		2
ME 411, Intro to Nuclear Engr		3
ME 412, Engr Measurements		3
ME 421, Theory of Vibrations	3	
ME 442, Machine Design	3	
ME 454, Heat and Mass Transfer	3	
ME 456, Mech Systems Lab II	1	
ME 461, 462, Design Project I, II	3	3
Humanities, Soc Sci Electives		3
Technical Electives[1]	3	3
Totals	17	17
Currriculum Total		135

Injection Molding Option	**Credits**	
Third Year	**F**	**S**
ECE 301, 303, 306, Elec Engr I, II, Lab	3	3,1
Engr 320 Technical Communication		3
IME 435, Adv Process Engr		3
ME 291, Injection Molding Lab/Seminar	1	
ME 331, Engr Materials I	4	
ME 341, Mech of Machinery	3	
ME 352, Fluid Dynamics	3	
ME 353, Thermodynamics II		3
ME 423, Intermediate Mechanics of Materials		3
ME 455, Mech Systems Lab I		1
IME 460, Eval of Engr Data	3	
Totals	17	17
Fourth Year		
Engr 402, Prof Ethics	1	
IME 440, Engr Economy		2
ME 473, Engr Plastics for Design	3	
ME 332, Engr Materials II		3
ME 411, Intro to Nuclear Engr		3
ME 412, Engr Measurements		3
ME 421, Theory of Vibrations		3
ME 442, Machine Design	3	
ME 454, Heat and Mass Transfer	3	
ME 456, Mech Systems Lab II	1	
ME 463, 464, Plastics Design Project I, II	3	3
Humanities, Soc Sci Electives	3	
Totals	17	17
Curriculum Total		135

Polymers and Coatings Option	**Credits**	
Third Year	**F**	**S**
Chem 341, 341L, 342, Organic Chem I & II, Lab I	3	1,3
ECE 301, 303, 306, Elec Engr I, II, Lab	3	3,1
Engr 320, Technical Communication	3	
ME 331, Engr Materials I	4	
ME 332, Engr Materials II		3
ME 341, Mech of Machinery	3	
ME 352, Fluid Dynamics	3	
ME 353, Thermodynamics II		3
ME 423, Intermed Mech of Materials		3
ME 455, Mech Systems Lab I		1
Totals	19	18
Fourth Year		
Engr 402, Prof Ethics	1	
IME 440, Engr Economy		2
ME 412, Engr Measurements		3
ME 421, Theory of Vibrations		3
ME 442, Machine Design	3	
ME 454, Heat and Mass Transfer	3	
ME 456, Mech Systems Lab II	1	
ME 463, 464, Plastics Design Project I, II	3	3
ME 473, Engr Design with Plastics	3	
ME 474, Mech of Composite Materials		3
P&C 474, 475, 484, Coatings I, II, Lab	3,2	3
Totals	19	17
Curriculum Total		144

Power Option	**Credits**	
Third Year	**F**	**S**
ECE 301, 303, 306, Elec Engr I, II, Lab	3	3,1
Engr 320, Technical Communication	3	
IME 460, Eval of Engr Data		3
ME 331, 332, Engr Materials I, II	4	3
ME 341, Mech of Machinery	3	
ME 352, Fluid Dynamics	3	
ME 353, Thermodynamics II		3
ME 423, Intermediate Mechs of Materials	3	
ME 442, Machine Design I		3
ME 455, Mech Systems Lab I		1
Totals	19	17
Fourth Year		
ECE 431, Power Systems	3	
ECE 433, Power Systems Design		3
Engr 402, Prof Ethics	1	
IME 440, Engr Economy		2
ME 411, Intro to Nuclear Engr		3
ME 412, Engr Measurements		3
ME 421, Theory of Vibrations	3	
ME 454, Heat and Mass Transfer	3	
ME 456, Mech Systems Lab II	1	
ME 465, 466, Power Systems Design Proj I, II	3	3
ME 481, Energy Conversion	3	
Humanities, Soc Sci Electives		3
Total	17	17
Curriculum Total		138

[1]Technical electives: Student must select two of the following courses: ME 471, 473, 474, 475, 477, 481, 484, 485, 486, 487, and 489 or other as approved.

Military Science (Army ROTC)

The Army Reserve Officers Training Corps (Army ROTC) program is conducted by the Department of Military Science. Army ROTC gives students the opportunity to become involved in a unique program that adds the leadership dimension to their college education. It also provides several financial assistance options. Students, regardless of their majors, are eligible to participate in this program. The primary objective of the program is to provide the knowledge and skills required for men and women to serve as commissioned officers in the active Army, Army Reserve, or Army National Guard. NDSU's Military Science Department is seeking students who have leadership potential, particularly those who are scholars, athletes and leaders.

The Army ROTC program is a four-year program of instruction in the military sciences taken in conjunction with a normal curriculum. Advanced placement credit may be received for previous or current military service. The program, (totaling 22 credit hours) can lead to a minor in military science. The program is divided into two parts: the basic course and the advanced course.

The basic course is normally taken during the freshman and sophomore years. Students participating in the basic course incur no military obligation or commitment. Instruction offered in the basic course include: physical fitness class, military leadership and management, land navigation, U.S. military history, first aid, tactics, and drill and ceremonies. Military skills laboratories also are offered. These include adventure activities such as rappelling, rope bridging, tactics, military equipment use, drill and ceremony, survival techniques, and a leadership reaction course.

Students entering the advanced course must have a minimum of two years of academic work remaining in a curriculum leading to either a baccalaureate or graduate degree. Students may qualify for entry into the advanced course by one of the following: completing basic training, attending the five-week ROTC National leadership Course, or having prior military service in any of the armed forces of the United States. Members of the Army National Guard or Army Reserve may qualify for direct entry into the advanced course and can maintain membership in their Guard/Reserve Unit by enrolling for the Simultaneous Membership Program (SMP) option.

Scholarship cadets and advanced course students receive a monthly monetary tax-free allowance of $250 to $400 per month (tiered from freshman through senior year).

Advanced course students receive instruction in advanced leadership and management and are afforded the opportunity to apply their acquired knowledge to practical situations. Military skills laboratories are also offered. In addition to the listed military science curriculum, advanced course students must complete an approved course in written communication skills, military history, and computer literacy.

Students also attend the five-week National Advanced Leadership Course at Fort Lewis, Washington (near Seattle) between the first and second year of the advanced course. The National Advanced Leadership Course is designed to develop and evaluate a student's judgment and decision-making abilities, build physical endurance and self-confidence, and allow a student to apply leadership skills. Leadership positions are rotated among the students so that each person experiences firsthand what it takes to apply leadership skills and develop an organization.

Four-, three-, and two-year scholarships are available. Army ROTC scholarships provide for payment of tuition and fees, receive $300 per semester for books and equipment, and an allowance of $250 to $400 per month for each year the scholarship is in effect. Generally, four-year scholarships are awarded to high school students who wish to compete during their senior year for a scholarship, but college freshmen also have been awarded this highly desirable scholarship.

Students who do not qualify for the ROTC program or who do not wish to pursue an officers' commission may audit courses in the advanced ROTC program, if approved by the professor of military science. Auditing students' participation is limited to the classroom and they are not eligible for monetary allowances.

For detailed information on the Army ROTC program, contact the Department of Military Science, 1-800-798-7575 or 231-7575, visit Room 103 in the Bentson/Bunker Fieldhouse on the NDSU campus, or visit our Website at www.tri-armyrotc.com.

Basic Course Curriculum

	Credits F	S
MS 110, Army ROTC Fitness	2	2
MS 111, 112, Introduction to ROTC	1	1
MS 211, Team Development	2	
MS 212, Team Military Tactics		2

Advanced Course Curriculum

MS 311, Leading Small ORG I	3	
MS 312, Leading Small ORG II		3
MS 313, Advanced Camp Summer (Junior Year)		
MS 320, Leadership Lab	1	1
MS 411, Leadership Challenge and Goals	3	
MS 412, Transaction to Lieutenant		3
MS 420, Leadership Lab	1	1
Totals	13	13

Natural Resources Management

The natural resources management major is a multidisciplinary program and is available in the College of Engineering and Architecture through the following departments: Agricultural Engineering, Civil Engineering, and Landscape Architecture. For a description of the program, refer to the College of Agriculture section.