

***POTENTIAL FOR EXPANDING  
GRADUATE TRANSPORTATION EDUCATION OPTIONS  
WITHIN THE NORTH DAKOTA UNIVERSITY SYSTEM***

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## ABSTRACT

In 1993, NDSU established graduate transportation options in civil engineering and agricultural economics. Since many aspects of the transportation programs are interdisciplinary in nature, the potential exists for expansion to other departments at NDSU, and for increased coordination within the NDUS.

In this report, commonalities in the graduate curricula of agricultural economics, business, civil engineering, industrial engineering, and public administration are analyzed. The study finds considerable potential for coordination of the UND MPA and the NDSU CE programs in the delivery of courses and masters degrees to North Dakota Department of Transportation engineers. Moreover, potential exists for civil engineering students to utilize business management and industrial engineering electives in their programs of study. Similarly, students in business administration and industrial engineering could benefit from existing civil engineering and agricultural economics transportation courses.

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## INTRODUCTION

A major objective of the University Transportation Centers Program (UTCP) is to foster the development and continuation of interdisciplinary, multimodal graduate programs at American universities. The intent of these programs is to “educate the new transportation professionals of tomorrow,” and to provide these people with interdisciplinary problem-solving skills and a knowledge of all surface and freight transport modes.

In 1993, the departments of agricultural economics and civil engineering, and the Upper Great Plains Transportation Institute, initiated a process that resulted in graduate transportation options in agricultural economics (AGECON) and civil engineering (CE). These master degree options feature a common set of five interdisciplinary courses available to students from both disciplines. Several resident students have already matriculated through both program options. Moreover, several North Dakota Department of Transportation (NDDOT) students are approaching completion of the program. These students — located in Bismarck — are taking classes via IVN and TEL8 (which are interactive video telecommunications systems that both NDSU and the NDDOT are connected to).

The future of the graduate transportation program is still somewhat fluid. There are ample opportunities for growth of existing options and for expansion of the program into new areas. Contacts have been initiated with several other departments regarding coordination of courses, promotion of transportation courses as technical electives for students in those majors, and other related issues.

The primary objectives of this report are to: 1) describe areas of potential growth in graduate transportation education at NDSU, 2) identify areas of common interest among departments and

departments and programs, and 3) identify any institutional or other obstacles to future integration and expansion. The report is organized as follows. First, some general background material is presented regarding potential alliances among disciplines, including a discussion of which disciplines are most frequently allied in graduate transportation programs in the United States. Second, the graduate courses offered by potential participating departments at NDSU are discussed and compared, and commonalities among course offerings and descriptions are noted. Third, potential options for continued growth and expansion of graduate transportation are discussed. Fourth, obstacles or issues associated with program growth and expansion are highlighted.

#### **SCOPE OF GRADUATE TRANSPORTATION PROGRAMS IN THE U.S.**

Most graduate transportation programs in the U.S. are of two types: 1) specialized transportation degrees and 2) masters degrees with a transportation emphasis or option.

In 1988, the Urban Mass Transit Administration found at least 13 graduate programs that offered a specialized degree in transportation (UMTA, 1988). These universities include: Northwestern, MIT, and the University of Pennsylvania.

In addition, UMTA found 116 graduate programs that offer a transportation emphasis or concentration instead of a specific degree in transportation (UMTA, 1988). In their study, UMTA found that the most common type of transportation emphasis was in civil engineering, followed by business administration.

A more recent survey identified 31 graduate programs in urban and regional planning that offer a transportation emphasis (Turnbull, 1995). Ten of these programs are concurrent or joint programs with civil engineering departments.

### **DISCIPLINARY THEMES**

All of the disciplines discussed above have contributed in some way to the overall body of knowledge and techniques used by transportation professionals.

Civil engineering programs primarily focus on the design, construction, and maintenance of transportation facilities and vehicles. However, many theories and models of travel behavior, traffic flow, and transportation operations have originated from civil engineering programs.

Turnbull (1995) found that the four most common subject areas in urban and regional planning programs are: 1) transportation planning theory and process, 2) urban transportation modeling, 3) transportation and land use, and 4) transportation policy. Other major subjects include: public transportation, transportation systems, and transportation economics.

UMTA (1988) concluded that most business programs focus on "physical distribution and business logistics," which include topics such as "materials management" and "transportation services purchasing." Some business colleges also emphasize transportation economics, as do some agricultural economics departments. Such programs typically focus on techniques for evaluating transportation investments and decisions, regulatory economics, and carrier management.

Many of the spatial theories and models of transportation and land use interaction, and (more recently) geographic information systems, have originated from the discipline of



geography. Moreover, some industrial engineering programs include courses in engineering logistics, operations research techniques, and industrial management concepts.

Clearly, the disciplines listed above exhibit many areas of commonality and complementarity. The trend, over time, is for common themes and interdisciplinary problems and case studies to emerge in an ad hoc manner. Students in certain disciplines (e.g. civil engineering) may take technical electives in other disciplines that are complementary in nature, or tend to “round-out” the student’s background. Instead of this unplanned evolution and integration, NDSU hopes to proceed in a planned, informed manner. A major purpose of this study is conduct a systematic evaluation and juxtaposition of existing curricula, to identify areas of future interdisciplinary cooperation or integration.

### **NDSU GRADUATE PROGRAMS**

North Dakota State University does not have an urban and regional planning department. However, NDSU does have civil engineering, agricultural economics, business administration, and industrial engineering programs. Each of these programs have incorporated some aspects of transportation or logistics. Moreover, NDSU has already established five interdisciplinary multimodal courses in transportation that are open to students in agricultural economics and civil engineering. These courses are shown in Figure 1.

**Figure 1. Multimodal Interdisciplinary Core Courses**

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**AGECON/CE 771 Rural and Non-Metropolitan Transportation.** Impacts of transportation on the economy and industry; transportation economics and cost analysis; the railroad and motor carrier industries; statewide highway planning; truck-size and weight issues; introduction to inland waterway transportation (3 hrs.)

**AGECON/CE 772 Rural Logistics and Distribution Management.** Logistical systems and concepts, distribution management, management of railroads and motor carriers, and location of facilities, plus agribusiness and natural resource case studies. (3 hrs.)

**AGECON/CE 774 Statewide Transportation Planning.** Transportation institutions, multimodal and intermodal transportation planning techniques, statewide planning guidelines, and management systems concepts. (3 hrs.)

**AGECON/CE 777 Analytic Techniques in Transportation.** Advanced transportation demand analysis, mathematical programming and transportation network analysis, and economic analysis of transportation investments. (3 hrs.)

**AGECON/CE 778 Transportation Administration.** Public organizational behavior and administration, fund accounting, public budgeting, financial management, performance evaluation and strategic management of transportation agencies. (3 hrs.)

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In addition to the five core transportation courses, the civil engineering department offers 48 other graduate courses. A partial list of courses that might be used as technical electives for transportation engineering students is presented in Figure 2.

## Figure 2. NDSU Civil Engineering Course Descriptions

**CE 615 Civil Engineering Systems.** Planning, evaluation, management, and modeling of civil engineering projects using systems approach; CPM analysis, simulation of decision analysis; optimization techniques utilizing computers and micro-computers. Two one-hour lectures. Prereq. Math 260. (2 hrs.)

**CE 617 Slope Stability and Retaining Walls.** Performance and design of retaining walls, sheet pile walls, braced walls, and reinforced earth. Also evaluation and correction of unstable earth slopes. Two one-hour lectures. Prereq. CE 316. (2 hrs.)

**CE 618 Transportation Engineering.** Location, analysis, modeling, and design of multi-modal facilities including highways, railways, airports, terminals, harbors, ports, canals, waterways, pipelines, and conveyor systems. Three one-hour lectures, one two-hour session. Prereq. CE 204. (4 hrs.)

**CE 619 Pavement Design.** Design of flexible and rigid pavements including subgrade, base courses, surface courses; evaluation criteria including soil, climate, traffic, material, drainage, initial and maintenance cost considerations; construction practices. Two one-hour lectures, one two-hour session. Prereq. CE 316. (3 hrs.)

**CE 621 Open Channel Flow.** Geometric and hydraulic properties of open channels, momentum and energy principles, design of channels for uniform flow, gradually varied and rapidly varied flow. Two one-hour lectures. Prereq. CE 309. (2 hrs.)

**CE 651 Advanced Surveying.** Property description and legal land surveys. Astronomical observations to establish position and direction. State plane coordinates. Two one-hour lectures. Prereq. CE 204. (2 hrs.)

**CE 654 Geometric Highway Design.** Location and design of highways and streets; design controls, elements of design; cross-section and alignment; design of intersections, interchanges, safety appurtenances, and noise barriers. Two one-hour lectures, one two-hour session. Prereq. CE 418. (3 hrs.)

**CE 655 Airport Planning and Design.** System planning and demand forecasting; siting and configuration of airports; aircraft characteristics; air traffic controls; standards for geometric design, pavements design, earthwork drainage, lighting, and marking. Two one-hour lectures. Prereq. CE 418, 419. (2 hrs.)

**CE 656 Railroad Planning and Design.** Rail planning and location analysis; track/rail structure; track layout and control system; locomotives and train resistance; track safety standards and geometric; terminal design. Two one-hour lectures. Prereq. CE 418. (2 hrs.)

**CE 657 Pavement Management Systems.** Pavement design, maintenance, and rehabilitation strategies; planning, budgeting, and programming for pavement management at network and project levels; development, design, and maintenance of pavement management systems. Two one-hour lectures. Prereq. CE 418, 419. (2 hrs.)

**CE 683 Contracts and Specifications.** Formation, interpretation, and termination of engineering contracts. Engineering specifications and drawings. Other legal matters of concern to engineers. Two one-hour lectures. Prereq. senior standing. (2 hrs.)

**CE 780 Transportation Planning.** Development and trends in travel demand forecasting; trip generation, trip distribution, mode choice, traffic assignment; transportation plans for modal, multi-modal, and paratransit alternatives; policy formulation and analysis. Three one-hour lectures. Prereq. CE 418. (3 hrs.)

**CE 781 Traffic Engineering.** Traffic characteristics, studies and control devices, operations analysis and design; aspects of signing, signalization, markings and lighting; accident analysis; traffic laws ordinances; work zone safety practices. Two one-hour lectures, one two-hour lab. Prereq. CE 418. (3 hrs.) lectures.

North Dakota State University's agricultural economics graduate courses (in addition to the core transportation courses) are shown in Figure 3. Since the inception of the transportation option, a transportation component has been added to the Agricultural Marketing course. This

component focuses on railroad logistics and car supply issues and the manner in which they impact grain marketing.

### **Figure 3. NDSU Agricultural Economics Graduate Courses**

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**AG/ECON 701 Research Philosophy.** Role of the scientist, reasoning, values, and decisions. Problem formulation, literature review, hypothesis development, data collection, analysis, and interpretation. Prereq. Ag. Ec. 797/798. (1 hr.)

**AG/ECON 710 Econometrics.** Applications of statistical methods to specification, estimation, and forecasting of linear economic models including multiple regression models, cross-section data analysis, time-series data analysis, and qualitative dependent variable models. Prereq. Ag. Ec. 701, Stat. 331. (2 hrs.)

**AG/ECON 711 Econometric Applications.** Specification, estimation, and forecasting of linear single and multi-equation economic models including distributed lag models, pooling models of cross-section and time series data, simultaneous equation models, and time-series models. Prereq. Ag. Ec. 710, Econ. 741. (2 hrs.)

**AG/ECON 739 Analytical Methods for Applied Economics.** Study and application of operations research techniques and other decision methods to problems in agriculture, transportation, and resource management. Prereq. Ag. Ec. 710, Econ. 741. (3 hrs.)

**AG/ECON 744 Agricultural Marketing.** Course investigates agricultural firm-level marketing with emphasis on competition and strategies. Prereq. Ag. Ec. 710, Econ. 741. (3 hrs.)

**AG/ECON 746 Rural Industry Finance.** Course discusses the problems of financial markets and intermediation, capital budgeting, portfolio analysis, capital rationing, financial institutions, and insurance face by rural business firms. Prereq. Econ. 741. (3 hrs.)

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In the original plan for the transportation options (developed in 1992), several sample programs of study were formulated for agricultural economics and civil engineering students. Moreover, several academic tracks were formulated for agricultural economics students. These three tracks — 1) transportation planning, 2) logistics and marketing, and 3) transportation economics — can be constructed from combinations of courses and a research/thesis focus.

Sample plan A programs of study are shown for the first two academic tracks in Figures 4 and 5, respectively. In the transportation planning track, students may select the *Statewide Transportation Planning* and *Transportation Administration* courses, both which focus on transportation planning and administration of state departments of transportation. This track provides students with an understanding of state and public transportation agencies and planning issues. Alternatively, AGECON students could substitute technical electives such as *Agricultural Marketing*, *Rural Industry Finance* or *Econometric Applications* for the two state agency transportation courses. When combined with a related thesis topic, these substitutions shift students into a logistics and marketing track where the primary orientation is toward agribusiness instead of state government. Other combinations of courses also are possible and specifically tailor a student's program of study to his or her academic and career objectives.

## Figure 4. Transportation Planning Track

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SAMPLE PLAN A PROGRAM OF STUDY  
for  
MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS  
with a TRANSPORTATION Option  
*Transportation Planning Track*

AGECON CORE

■ AGECON 701	Research Philosophy	1 credit	
■ AGECON 710	Econometrics		2 credits
■ AGECON 739	Analytic Methods		3 credits
■ ECON 741	Microeconomics		<u>3 credits</u>
			9 credits

TRANSPORTATION CORE

■ AGECON 771	Rural & Nonmetropolitan Transp.	3 credits	
■ AGECON 777	Analytic Techniques in Transp.		3 credits
■ AGECON 772	Logistics & Distribution Management		3 credits
■ AGECON 774	Statewide Transportation Planning		3 credits
■ AGECON 778	Administration of Transp. Agencies		3 credits
■ AGECON 790	Seminar in Transportation	<u>1 credit</u>	
			16 credits
■ AGECON 798 Thesis		6 credits	

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**Figure 5. Logistics & Marketing Track**

**SAMPLE PLAN A PROGRAM OF STUDY**  
for  
**MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS**  
with a **TRANSPORTATION Option**  
*Logistics & Marketing Track*

**AGECON CORE**

■ AGECON 701	Research Philosophy	1 credit	
■ AGECON 710	Econometrics		2 credits
■ AGECON 739	Analytic Methods		3 credits
■ ECON 741	Microeconomics		<u>3 credits</u>
			9 credits

**AGECON ELECTIVES**

■ AGECON 744	Agricultural Marketing	3 credits	
■ AGECON ***	Technical Elective		<u>3 credits</u>
			6 credits

**TRANSPORTATION CORE**

■ AGECON 771	Rural & Nonmetropolitan Transp.	3 credits	
■ AGECON 777	Analytic Techniques in Transp.		3 credits
■ AGECON 772	Logistics & Distribution Management		3 credits
■ AGECON 790	Seminar in Transportation	<u>1 credit</u>	
			10 credits
■ AGECON 798	Thesis		6 credits

**Figure 6. Transportation Engineering Plan of Study # 1**

**SAMPLE PLAN A PROGRAM OF STUDY  
for  
MASTER OF SCIENCE DEGREE IN CIVIL ENGINEERING  
with a TRANSPORTATION Option**

For students with undergraduate transportation engineering background

**TRANSPORTATION CORE**

■ CE 771	Rural & Nonmetropolitan Transp.	3 credits
■ CE 777	Analytic Techniques in Transp.	3 credits
■ CE 774	Statewide Transportation Planning	3 credits
■ CE 790	Seminar in Transportation	<u>1 credit</u>
		10 credits

**TRANSPORTATION ELECTIVES**

■ CE 617	Slope Stability and Retaining Walls	2 credits
■ CE 621	Open Channel Flow	2 credits
■ CE 656	Railroad Planning & Design	3 credits
■ CE 781	Traffic Engineering	<u>3 credits</u>
		10 credits

**OTHER ELECTIVES**

■ STAT 661	Applied Regression Models	3 credits
■ IE 655	Management of People Systems	<u>2 credits</u>
		5 credits
■ CE 798	Thesis	6 credits



## Figure 7. Transportation Engineering Plan of Study # 2

### SAMPLE PLAN A PROGRAM OF STUDY for MASTER OF SCIENCE DEGREE IN CIVIL ENGINEERING with a TRANSPORTATION Option

For transportation agency students with undergraduate transportation engineering background

#### TRANSPORTATION CORE

■ CE 771	Rural & Nonmetropolitan Transportation	3 credits
■ CE 777	Analytic Techniques in Transp.	3 credits
■ CE 772	Logistics & Distribution Management	3 credits
■ CE 774	Statewide Transportation Planning	3 credits
■ CE 778	Transportation Administration	3 credits
■ CE 790	Seminar in Transportation	<u>1 credit</u>
		16 credits

#### TRANSPORTATION ELECTIVES

■ CE 656	Railroad Planning & Design	3 credits
■ CE 781	Traffic Engineering	<u>3 credits</u>
		6 credits

#### OTHER ELECTIVES

■ STAT 725	Applied Statistics	3 credits
■ CE 798	Thesis	6 credits

Figure 8 lists some of the graduate courses offered in business administration. This list includes only management and administrative courses (as opposed to accounting or market finance courses).

Four business courses appear to offer some potential for integration into transportation programs of study: 1) BUSN 650 *Human Resource Management*, 2) BUSN 683 *Organizational Communication*, 3) BUSN 750 *Advanced Organizational Behavior*, 4) BUSN 789 *Strategic Management*. *Organizational Communication* is cross-listed with *Speech Communication* and explores management communication processes in organizations. *Human Resource Management* covers effective workforce management practices and job design, including such topics as compensation and benefits, collective bargaining and performance evaluation. *Advanced Organizational Behavior* has a prerequisite course: BUSN 350. However, the business administration department will allow North Dakota Department of Transportation employees with graduate standing and substantial job experience to take the course on a trial basis. A more formal arrangement is currently being pursued wherein the *Transportation Administration* course would count as a prerequisite for NDDOT students without substantial work experience.

*Advanced Organizational Behavior* is scheduled for delivery over IVN in the Fall of 1996 and 1997. Thus, NDDOT students currently enrolled in the masters degree program will be able to include this course in their programs of study.

Figure 9 is a partial list of industrial engineering graduate courses offered at NDSU. Six IE courses appear to hold promise as possible technical electives for transportation students in other departments: 1) IE 640 or 740 *Engineering Economy*, 2) IE 651 *Logistics Engineering and Management*, 3) IE 655 *Management of People Systems*, 4) IE 656 *Program and Project*

*Management*, 5) IE 670 *Operations Research I*, 6) IE 671 *Operations Research II*. One of the transportation engineering programs of study (shown Figure 6) includes IE 655— Management of People Systems.

### **UNIVERSITY OF NORTH DAKOTA MPA PROGRAM**

The University of North Dakota offers a public administrative masters degree which is delivered to the state capitol via IVN (Figure 10). At present, one NDSU CE graduate student is jointly enrolled in the UND MPA program.

Many of the UND courses hold promise as possible technical electives for transportation students, particularly 502, 508, 535, and 539. Also, the two-part research methods course — 500 and 501 — could be useful to transportation students. Some overlap is likely to occur between UND/MPA 535 and 537 and the NDSU Transportation Administration course.

Currently, UND allows their MPA students to take a cognate of six to nine hours in NDSU transportation courses. Discussions are underway to open several of UND's MPA courses to state government CE students, and to promote further integration.

## Figure 8. NDSU Business Administration Courses

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**BUSN 650 Human Resource Management.** A study of the concepts, current practices, functions and legal constraints involved in the management of an effective workforce including job analysis and design, compensation and benefits, performance evaluation, and collective bargaining. (3 hrs.)

**BUSN 660 Consumer Behavior.** Examines dimensions of consumer buying theories, with the objective of understanding the buying behavior of the firm's customers. Prereq. Busn. 360. (3 hrs.)

**BUSN 661 Advertising and Promotion Management.** Examines the use of advertising as part of the worldwide marketing function; prepares the student to analyze and create new advertising campaigns. Prereq. Busn. 360. (3 hrs.)

**BUSN 662 Sales and Sales Force Management.** Examines the different aspects of effective personal selling and also focuses on decision areas pertaining to sales force management. Prereq. Busn. 360. (3 hrs.)

**BUSN 663 Industrial Marketing.** Marketing of goods and services to commercial enterprises. Includes strategies, product planning, pricing, and promotion directed toward business firms. Prereq. Busn. 360. (3 hrs.)

**BUSN 683 Organizational Communication.** Explores the theory of management communication practices in organizations with emphasis on the study of formal structure and the interpersonal aspects of supervisory-subordinate relations (cross-listed with Speech Communication). (3 hrs.)

**BUSN 750 Advanced Organizational Behavior.** A study of the theories and current research dealing with individual and small-group behavior in organizations. Topics include learning, motivations, job satisfaction, stress, and performance. Prereq. Busn. 350. (3 hrs.)

**BUSN 751 Quantitative Models for Business.** Development and application of quantitative techniques and mathematical models for management decision making. Prereq. Busn. 551. (3 hrs.)

**BUSN 760 Strategic Marketing and Sales Management.** Focuses on the major decision areas that marketing executives face in their efforts to match the objectives and resources of the organization with the needs and opportunities in the marketplace. Prereq. Busn. 360. (3 hrs.)

**BUSN 761 Marketing Research.** A research methods course with a focus on research design, data collection, and analysis techniques. Prereq. Busn. 760 and Stat. 331 or 725. (3 hrs.)

**BUSN 789 Strategic Management.** The processes and tools of strategy formulation and implementation in today's complex global environment. (3 hrs.)

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## Figure 9. NDSU Industrial Engineering Courses

- IE 611 Human Factors Engineering.** Issues concerning people, machines, and environments are investigated for productivity, fatigue, and safety factors. Covers work stations, information format and flow, controls and displays, instructions, and training. Prereq. IE 311, 460. (2 hrs.)
- IE 640 Engineering Economy.** Capital investment decision foundations within rules of general and project accounting. Benefits and returns are analyzed against cost for engineering installations. Buy-lease-rent decisions. Prereq. junior standing. (2-4 hrs.)
- IE 650 Systems Engineering and Analysis.** Integrates technical disciplines through stages of systems life cycle: needs, requirements, operating concepts, design and prototyping, test and evaluation, facilitization, manuals, training, and supportability. (2 hrs.)
- IE 651 Logistics Engineering and Management.** Extends systems, methods, production, inventory, and facility topics to integrated logistics support. Emphasizes reliability, maintainability, tools, test equipment, spares, operating and maintenance instructions, and training. Prereq. IE 450. (2 hrs.)
- IE 655 Management of People Systems.** Systems, contingency, and participative trends are experienced for people, resources, and work management in organizations. Individuals, groups, and teams are emphasized for culture of continual change. (2 hrs.)
- IE 656 Program and Project Management.** Integration of technical, business, and operational specialties in project consulting firm. Serve as a member of multiple disciplinary teams that design, plan, and present for a variety of industrial clients. Prereq. Approval of instructor. (3 hrs.)
- IE 660 Evaluation of Engineering Data.** Design of engineering experiments and evaluations, curve fitting, regression, hypothesis testing, ANOVA, Taguchi methods in engineering design. Prereq. Math. 161. (3 hrs.)
- IE 670 Operations Research I.** Techniques to optimize and analyze industrial operations. Uses linear programming, transportation models, networks, integer programming, goal programming, dynamic programming, and non-linear programming. Prereq. Math. 260. (3 hrs.)
- IE 671 Operations Research II.** Study of probabilistic operations research topics including queuing analysis, decision analysis, and markov decision processes. Prereq. IE 460, 470. (2-3 hrs.)
- IE 672 Simulation of Business and Industrial Systems.** Development of the fundamentals and techniques of simulating business and industrial systems. Monte-Carlo techniques and computer usage. Prereq. BASIC or FORTRAN and IE 460, 470. (3 hrs.)
- IE 680 Production and Inventory Control.** Planning and controlling of industrial production and inventory: demand forecasting, master scheduling, materials requirements planning, job scheduling, assembly line balancing, and just-in-time production. Prereq. IE 460, 470. (3 hrs.)
- IE 740 Advanced Engineering Economy.** Advanced topics in engineering economy including replacement analysis, capital budgeting, income tax effects on equipment selection, probabilistic models, and manufacturing costing. Prereq. IE&M 440. (3 hrs.)
- IE 770 Advanced Operations Research Topics.** Study of the theory and applications of linear programming, network flow, and nonlinear programming. Prereq. IE 470. (3 hrs.)
- IE 772 Advanced Simulation.** An in-depth study of special purpose simulation languages to model, analyzed, and design industrial and engineering systems. Stochastic and deterministic methods are included. Prereq. IE 472. (3 hrs.)
- IE 780 Advanced Production and Inventory Control.** Study of the theory and applications of production scheduling, inventory management, production planning, just-in-time production, and materials requirement planning. Prereq. IE 460, 470, and 480. (3 hrs.)

## Figure 10. Graduate Courses in Public Administration — University of North Dakota

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**UND 500 Research Methods.** This course will first focus on various approaches to analyzing political phenomena with the goal of developing students' ability to think analytically and to distinguish between empirical and normative analysis. The course will then introduce techniques of empirical research including research design, measurement, data gathering, and data analysis. Pre. Req. A statistics course or consent of instructor. (3 hrs.)

**UND 501 Political and Public Policy Analysis.** This course focuses on the use of empirical data both to develop empirical theory and to make policy choices. Topics to be discussed include hypothesis testing, public choice, and policy evaluation. Students will be required to complete an original research project. Pre. Req. Political Science 500 or consent of instructor. (3 hrs.)

**UND 502 Seminar: Problems in State and Local Governments.** Directed in-depth inquiry into contemporary structural and policy problems of state and local governments. During the course, each student will prepare a research paper relevant to a current problem suitable for publication and distribution to an identifiable body of public officials and citizens for problem-solving purposes. Pre. Req. Political Science 402 or consent of instructor. (3 hrs.)

**UND 508 Seminar: Legislative and Executive Processes.** Description, analysis, and evaluation of the structures, processes, procedures, and positions of the legislative and executive offices in government. (3 hrs.)

**UND 511 Seminar: Political Theory.** Study of major political theories and the methodologies employed in their formulation. Pre. Req. Political Science 311 or consent of instructor. (3 hrs.)

**UND 531 Seminar: Public Administration.** An extensive overview of Public Administration stressing the basic conceptions and trends in the discipline as well as the classic scholars. (3 hrs.)

**UND 532 Public Policy.** A discussion of the initiation, formulation, adoption, implementation, and evaluation of American public policy. Various policy areas such as agriculture, education, environment, and welfare will be analyzed. (3 hrs.)

**UND 535 Public Organization.** Description and analysis of bureaucratic organizations with particular emphasis on concepts and characteristics common to public bureaucracies. (3 hrs.)

**UND 537 Administering the Public Bureaucracy.** Introduces the graduate student to the dynamics of public personnel administration and public sector budgeting. The contrasting norms and behaviors of participants, their impacts on policy, and the implications for government are examined. Specific processes include financial control, performance appraisal and intergovernmental interaction. (3 hrs.)

**UND 539 Administrative Law.** Study of the legal dimension of public administration. Study of requirements for rule-making and adjudication and of judicial review of administrative decisions. (3 hrs.)

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## CONCLUSIONS

Considerable opportunities exist for extension of the graduate transportation option within the North Dakota State University System. A variety of potential options exist for agricultural economics and civil engineering students to take technical electives in business, public administration, and industrial engineering. However, several issues require further discussion: 1) departmental prerequisites, 2) appropriate mix of off-campus and local courses, and 3) satisfaction of departmental "turf" concerns. However, all of these issues appear to be solvable (some on a case-by-case basis). Currently business and industrial engineering students are able to take some of the transportation courses as technical electives, and some of the technical electives as transportation courses. Further integration is possible in future years.

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