TRANSPORTATION (TR-GY)

TR-GY 900X Readings in Transportation (1-3 Credits)
Typically offered Fall, Spring, and Summer terms
This is an individually guided effort involving research into a topic of interest, usually growing from a course the student has taken. Readings courses should not duplicate material available in a regularly scheduled course, but should involve additional research on a topic or topics of interest to the student that is related to a course or courses. A formal written report is required. The student must have a faculty advisor who agrees to work with them and an agreed-upon topic before registering. The student may register for 1 to 3 credits for a readings effort, in proportion to the effort and as approved by the supervising instructor. | Prerequisite: Permission of supervising instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: Permission of supervising instructor.

TR-GY 997X MS Thesis in Transportation (3-6 Credits)
Typically offered Fall, Spring, and Summer terms
Students electing to take a 6-credit MS Thesis commit to a significant individually guided research effort, resulting in a formally defended thesis report, bound in accordance with Institute requirements. | Prerequisites: MS degree status and permission of thesis adviser.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes

TR-GY 999X PHD Dissertation in Transportation Planning & Engineering (3-12 Credits)
Typically offered Fall and Spring
The dissertation is an original investigation embodying the results of comprehensive research in a specific area of transportation worthy of publication in a recognized, formally refereed transportation journal. Students must defend formally their dissertations and submit a bound written document. Students must complete a minimum of 24 credits of dissertation registration before defending. Once the dissertation is started, the student must maintain a minimum of 3 credits of registration during each semester (not including summer) until the dissertation is complete. During the last semester of registration, the student may be permitted to register for 1/2 credit with the permission of the Graduate Office and dissertation adviser. | Prerequisite: PhD degree status, passage of the Qualifying Examination in Transportation and permission of the dissertation adviser.
Grading: Satisfactory/Unsatisfactory
Repeatable for additional credit: Yes
Prerequisites: RE-GY 9990 and PHD Transportation Systems major.

TR-GY 6013 Fundamental Concepts in Transportation (3 Credits)
Typically offered Spring
This course provides the contextual foundations to study urban transportation systems, using performance criteria reflecting the perspectives of system providers/owners, users and communities. The connection between transportation supply, travel demand, service volume and level of service is explored and quantified for various travel modes. The impacts of transportation system performance on travel behavior, communities and the environment is discussed. The role of technology and institutions is examined with case examples. | Prerequisite: Graduate status or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate status or permission of instructor.

TR-GY 6053 Transportation Economics and Finance Fundamentals (3 Credits)
In this course, we will discuss the fundamentals of economic theory and their application to the modeling and analysis of transportation systems. We will approach transportation systems as markets and study the resulting supply-demand equilibrium in these markets. Starting from concepts of utility maximization, we will explore how individuals optimally choose between alternatives and how these choices give rise to the demand functions for different services. Then, we will investigate the supply side and study provision of the aforementioned services. Lastly, we will study strategic interactions between different actors in the transportation market and how these interactions affect market outcomes. This will allow us to confidently approach and apply equilibrium analysis to transportation systems to derive insights as to their performance, their design and their regulation. Examples will be primarily drawn from, among other things: ride-hailing markets, network planning and design, parking provision and location for connected and autonomous vehicles, land use and automation, congestion pricing. | Prerequisite: Knowledge of a programming language (e.g.: C++, Julia, Python…), of a scripting language (e.g.: MATLAB…) or of an algebraic modeling language (e.g.: GAMS…) is strongly recommended due to the nature of some of the assignments.
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 6113 Forecasting Urban Travel Demand (3 Credits)
Typically offered occasionally
The purpose of this course is to study methods and models used in estimating and forecasting person travel in urban areas. The objective is to understand the fundamental relationships between land use, transportation level of service and travel demand, and to apply methods and state-of-the-practice models for predicting person travel on the transportation system. | Prerequisite/Corequisite: TR-GY 6013 or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 6223 Intelligent Transportation Systems and Their Applications (3 Credits)
Typically offered Fall
This course introduces the concepts and applications of Intelligent Transportation Systems (ITS) and its growing role in the management of transportation systems. The course stresses the role of ITS as national policy, as specified in major transportation funding legislation – ISTEA, TEA21 and SAFETY-LU. A systems engineering approach to overall development of ITS technologies is stressed. Major components of ITS are discussed, and examples of their application treated. Coordination and integration of ITS components are treated. | Prerequisite: Graduate status or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 6333 Transportation & Traffic Concepts, Characteristics & Studies (3 Credits)
Typically offered Fall
The course covers basic concepts in transportation and traffic engineering, including: volume, demand, and capacity; traffic stream parameters and their meaning; transportation modes and modal characteristics. The impact of traveler and vehicle characteristics on traffic flow and on other modes is presented and discussed. The importance of data collection is emphasized with sample studies, such as volume, speed and travel time, and safety. Capacity and level of service analysis for uninterrupted flow facilities, including freeways, multilane highways and two-lane highways is demonstrated using methodologies of the 2010 Highway Capacity Manual. | Prerequisite: Graduate standing or permission of instructor
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate standing or permission of instructor.

TR-GY 6343 Traffic Operations & Control (3 Credits)
Typically offered Fall
The course would focus heavily on signalization, with an introduction to simulation and signal timing tools. The course would cover warrants, timing pretimed signals, understanding actuated controllers and their settings, as well as detector types placement. | Prerequisites: Graduate standing or department consent
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate standing or departmental consent.

TR-GY 6403 Transportation & Traffic Project (3 Credits)
Typically offered Spring
This is a capstone course involving individual and/or group projects that include several different aspects of transportation planning and engineering. The project will be different each year, and focus on a problem of current interest and importance. | Prerequisites: TR-GY 6113, TR-GY 6333, TR-GY 6343 or permission of instructor
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: CE-GY 804 with a Minimum Grade of C AND TR-GY 6333 with a Minimum Grade of C AND TR-GY 6343 with a Minimum Grade of C.

TR-GY 7013 Urban Transportation & Logistics Systems (3 Credits)
Typically offered Fall
This course provides graduate students with operations research methods to solve logistics problems faced by decision-makers for congested urban infrastructure. Optimization and evaluation methods covered include linear programming, network flow, integer programming, vehicle routing, facility location, functions of random variables, Markov processes, (point, spatial, and Jackson) queueing, and queue tolling. Students will design and analyze a toy system related to one of the following applications: public transport, shared mobility, ITS applications, freight deliveries, traffic operations. | Prerequisites: Graduate Standing or Department Permission
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Standing or Department Permission.

TR-GY 7033 Multimodal Transportation Safety (3 Credits)
Typically offered occasionally
Technology, legislation and market forces have contributed to improved transportation safety for decades. But one must consider which metrics are most relevant for which modes, the role of demographics and traffic levels and other factors when analyzing and predicting safety trends. The course pays attention to a systems view, to metrics by mode and to both standard field and statistical analyses. Consistent with current priorities, the course addresses security as well as safety issues. | Prerequisite: Graduate status or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 7063 Stochastic Models and Methods for Engineering Systems (3 Credits)
Typically offered Spring
Basic theory of stochastic processes and random graphs with a variety of transportation applications. Random variables, events, laws of large numbers; Finite-state Markov chains, steady-state distribution, exponential convergence, Markov decision process; Poisson process, Little's theorem, M/M/1 queues, queuing networks, hybercube model, fluid model; Branching process, Erdős−Rényi model, geometric random graph; Applications in connected/autonomous vehicles, intersections, highway traffic, transit, patrol, emergency services, air transportation, infrastructure maintenance, urban development. | Prerequisites: Knowledge of Undergraduate course on calculus, probability, and linear algebra
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 7073 Travel Behavioral Informatics (3 Credits)
Typically offered Spring
This course teaches students how to design information systems for operating transportation facilities and services. The information systems are built on information obtained from a diverse population of travelers, and hence behavioral modeling is a crucial component. An introduction is provided of intelligent transportation systems (ITS): systems engineering, ITS architecture, and current ITS trends associated with behavioral information systems: e.g. cyber-physical transport systems, Internet of Things, and information & communications technologies (ICTs). An introduction to decision theory with incomplete information is provided based on different models random utility maximization: multinomial logit, probit, nested logit, mixed logit. Students will design tools based on behavioral choice models (for users) in a dynamic setting and construct simulation tests to evaluate them. A route choice information system (new technology marketing strategy, route diversion system, or fare/toll revenue management system) will be used as a case study. | Prerequisites: Graduate Standing or Department Permission
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Status.

TR-GY 7083 Analytics and Learning Methods for Smart Cities (3 Credits)
Typically offered Fall
Basics of analytics and learning methods, with applications in smart cities. Introduction of algorithms in their very basic forms. Implementation of common machine learning algorithms in coding languages. Smart city applications of machine learning algorithms. Topics include probability review, inference, linear regression, classification, neural networks, and introduction to reinforcement learning. Applications include autonomous vehicles, traffic control, public transit, ridesharing, urban emergency response, smart grid, and smart buildings. Intended for students interested in smart city applications. | Prerequisites: Knowledge of Statistics or Data Analysis or equivalent
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 7133 Urban Public Transportation Systems (3 Credits)
Typically offered Spring
This course provides a thorough understanding of policy, planning, operational and technical issues that affect urban public transportation. It includes the historical development of cites and the rise of urban transport. Also covered are the characteristics of various urban transportation modes (their specific operating and infrastructure characteristics), as well as key elements that are critical to service provision, such as service planning, scheduling, fare collection, communication and signaling, station design and customer service. The course offers a broad perspective on regional planning, capital programming and policy matters. Special focus will be on emerging technologies and their practical applications. | Prerequisite: Graduate status or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate status or permission of instructor.

TR-GY 7223 Management of Transit Maintenance and Operations (3 Credits)
Typically offered Spring
This course provides a comprehensive understanding of modern public transportation systems, emphasizing their technology and operational practices. Planning and management aspects are also covered. Such operational management issues as maintenance practices, scheduling, procurement and labor relations are broadly outlined and discussed. Planning and capital programming issues are also treated. | Prerequisites: Graduate status or permission of instructor.
Grading: Grad Poly Graded
Repeatable for additional credit: No
Prerequisites: Graduate Standing.

TR-GY 7353 Data-Driven Mobility Modeling & Simulation (3 Credits)
Typically offered occasionally
The goal of this course is to provide students with the tools and methods to understand basics of traffic flow theory, modeling and simulation. The emphasis will be on the use of real-world data to supplement the understanding of the theory behind theoretical models. Small-scale models will be developed in R or Python then tested and validated against real-world data. The use of some of the well-known microscopic, mesoscopic, and agent-based transportation / traffic modeling and simulation software tools such as SUMO and MATSIM will also be introduced using a hands-on approach with real-world transportation networks.
Grading: Grad Poly Graded
Repeatable for additional credit: No

TR-GY 8013 Selected Topics in Transportation I (3 Credits)
Typically offered occasionally
These courses are given as needed to present material on current topical subjects that are not expected to be given on a regular basis. The topic(s) for each offering are indicated and are listed on the student's transcript. These courses may be taken more than once if the listed topics are different. | Prerequisites: As approved for the topic(s); to be specified for each offering and Graduate Standing.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: Graduate Standing.

TR-GY 8023 Selected Topics in Transportation II (3 Credits)
Typically offered occasionally
These courses are given as needed to present material on current topical subjects that are not expected to be given on a regular basis. The topic(s) for each offering are indicated and are listed on the student's transcript. These courses may be taken more than once if the listed topics are different. | Prerequisites: As approved for the topic(s); to be specified for each offering and Graduate Standing.
Grading: Grad Poly Graded
Repeatable for additional credit: Yes
Prerequisites: Graduate Standing.