CE 597: Freight Transportation and Commodity Flows

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Prerequisite: Undergraduate calculus, knowledge of probability, statistics and linear algebra at the undergraduate level. Basics of transportation planning and optimization. Some programming experience. As a graduate elective, this course is appropriate for graduate students with an interest in learning about freight networks.

Credits: 3

Texts:

- No recommended text book. The material will be derived from various sources which will be distributed by the instructor
- (**FDM**): Freight Demand Modeling: Tools for Public-Sector Decision Making. Conference Proceedings 40. Transportation Research Board. National Academies, Washington, D.C. http://onlinepubs.trb.org/onlinepubs/conf/CP40.pdf
- (**QRFM**):FHWA Quick Response Freight Manual II: http://www.ops.fhwa.dot.gov/freight/publications/qrfm2/index.htm
- (**GAO**): U.S. Government Accountability Office Report on Freight Transportation: Strategies Needed to Address Planning and Financing Limitations. www.**gao**.gov/new.items/d04165.pdf
- (**UOR**): Chapter 6. Applications of Network Models. Urban Operations Research. Larsen and Odoni. http://web.mit.edu/urban_or_book/www/book/chapter6/contents6.html

Other References:

- Ahuja, R.K., Magnanti, T.L. and Orlin, J.B. *Network Flows: Theory, Algorithms and Applications*. Prentice-Hall Inc., 1993.
- Simchi-Levi, David; Chen, Xin; and Bramel, Julien. *The Logic of Logistics*, 2nd edition, Springer, 2005.
- Daganzo, Carlos, *Logistics Systems Analysis*, Fourth Edition, Springer, 2005.

Journal References:

Transportation Research – Part E
Transportation Research – Part B
Transportation Research Record

Course Description:

This course provides a foundation for the planning and operations of freight transportation systems. The course is broadly divided into two parts: (1) Freight Transportation Planning which provides an introduction to unique characteristics of freight transportation, demand forecasting, commodity flow modeling, data issues in freight planning and validation issues. (2) Freight Logistics which discusses the role of supply chain modeling in freight transportation, the nature of costs in freight networks, operational issues, vehicle routing problems, interactions of carriers and shippers using auctions and yield management. Freight studies from different states will be used as case studies to highlight the topics in this course. The course will use intuitive arguments and mathematical optimization tools will be used to illustrate many situations in a rigorous fashion.

Course Objectives:

A student completing this course is expected to:

1. Understand the unique nature of freight transportation and the role of freight as an economic driver
2. Understand the basics concepts and models for freight transportation planning
3. Understand the basics concepts of freight transportation logistics issues
4. Demonstrate the ability to develop appropriate quantitative tools for planning and logistics problems using optimization techniques and solve them using appropriate solution algorithms, techniques and software.

Tentative Course Outline:

Block 1 *Conceptual Foundation*

- Overview of Transportation Planning
- Nature of Freight Flows
- Freight Analysis Framework (FAF): Overview
- Different Actors in Freight Networks: Firms, Shippers and Carriers
- Basic Concepts in Optimization

Block 2 *Freight Transportation Planning*

- Freight Demand – Controlling Factors
- Incorporating Freight into the "Four Step" Travel Forecasting
- Commodity Flow Models (Forecasting, Assignment, FAF3)
- Hybrid Approaches : Case Study Los Angeles HDTV Model
- Economic Activity Models: Case Study of Oregon Forecasting Model
- Freight Data Collection and Data Sources and Issues (http://www.fhwa.dot.gov/freightplanning/data.htm)
- Model Validation and Application Issues
- Intermodal considerations in Freight Modeling (Drayage, Logistics Handling)

Block 3 *Freight Logistics and Supply Chain Modeling*

- Role of Supply Chain Modeling in Freight Transportation
- Emerging Logistics Practices: Role of Electronic Commerce
- Importance of Supply Chain Modeling: Shipper, Commodity, Logistic and Modal characteristics
- Operational Networks (Costs and modeling interdependencies)
- Shipper Perspective – Strategies and approaches for design and management (Vehicle Routing Problem)
- Routing and Scheduling Algorithms
- Procurement and Use of Combinatorial Auctions
- Carrier Perspective and Yield Management

Block 4 *Additional Topics*

- Network Design
- Supply Chain Contracts
- Auction in Freight Supply Chains

Format: Classes will be in a combination of lecture and discussion. Students are expected to participate actively in class discussions.

Homework:

- Five or Six problem sets will be given, and the analysis of these assignments will be the basis for some class discussion
- Problem sets are due at the beginning of class on designated days; late problem sets will not be accepted.

Grading Policy:

Problem Sets	25%
Exam	35%
Paper + Presentation	(35 + 5)%

For the problem sets, you may (are encouraged to) discuss with other students but the final written solution should be your own work. The exam will be open textbook and open class notes.

The paper must be scholarly and, if possible, should have some original input from the student. The paper should be prepared according to the guidelines of Transportation Research Record and should be of a comparable quality. The instructor will have the final approval of the topic.

Student Feedback:

Throughout the semester, students are especially encouraged to bring attention of the professor any difficulties/issues encountered during the lectures. The primary

purpose of this is to provide the instructor with continuous feedback on how to improve the classroom learning environment.

Academic Honor Code:
It is your responsibility to familiarize yourself with the Purdue Honor Code. Specifically, you must do your own work in all homeworks, projects, and exams; when homework or projects are specifically assigned to groups, you may and should work with the other members of your group.