

Traffic Planning and Operations

Civil Engineering 794

Spring 2002

Instructor Information

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Objectives

Traffic Planning and Operations is an advanced course in traffic engineering that deals with topics that are too specialized or too complicated for 240-592, Traffic Control. The major focus of the course will be the planning and operation of complex urban traffic systems, with an emphasis on optimized control strategies. Principles of ATMS (Advanced Traffic Management Systems), as they apply to both surface streets and freeways, will be covered. The course will build on theories of traffic flow, nonlinear optimization, stochastic processes, and queuing.

An emphasis will be placed on hands-on learning through short projects, workshops, demonstrations, and seminar sessions.

Readings

One of:

Highway Capacity Manual 2000 or

McShane, Roess and Prassas, *Traffic Engineering*, Second Edition

Selected Sections from:

Wayne L. Winston, *Operations Research: Applications and Algorithms*,
PWS-Kent, 1991

Articles from the Current Literature

Professional Software:

Traffic Operations: TRANSYT7-F, SYNCHRO, CORSIM, etc.

Travel Forecasting: GNE/QRS II

ITS Deployment: IDAS

Outline

0. Traffic Flow Theory

1. Introduction

- Course Planning and Overview
- Traffic Systems
- Traffic Engineering Approach to Traffic Problems
- Planning Approach to Traffic Problems, Diversion
- Overview of Traffic Analysis
- ITS and ATMS
- Overview of System Optimization
- Measures of Effectiveness

2. Mathematical Programming for Traffic System Optimization

- Linear Programming
- The Transportation Problem
- Single-Dimensional Nonlinear Programming
- Multi-Dimensional Nonlinear Programming
- Algorithms
- Applications to Planning
- Applications to Isolated Intersections
- Applications to Areawide Control Systems
- Assignment A: Optimize a Traffic Control

3. Measurement Issues

- Measuring Traffic Variables
 - Delay, Saturation Flow Rate, Queues, Service Times
- Statistical Issues
- Safety Measurement and Monitoring
- Assignment B: Measure a Traffic Situation

4. HCM Delay Relationships

- Uncontrolled Segments
- Multilane
- Ramps
- Weaving Sections
- Two-lane Roads
- Signalized Intersections
- Stop Controlled Intersections
- Worksheets and Procedures

Midterm Examination

5. Traffic Assignment
 - User-Optimal Equilibrium
 - System-Optimal Equilibrium
 - Elastic-Demand and Diversion Issues
 - Multiple Solution Issues
 - Dynamic Traffic Assignment
 - Algorithms and Examples
 - Assignment C: Assign Some Traffic

6. Queuing Delay in Interrupted Flow
 - Review of Probability Concepts
 - Basic Queues
 - Two-way Stop Queues
 - Four-way Stop Queues
 - Relationship to HCM
 - Assignment D: Design a System for Optimal Delay

7. Other Approaches to Traffic Simulation
 - Use of Probability Distributions for Traffic Simulation
 - Monte Carlo Techniques
 - Relationship to Planning and Traffic Software
 - Assignment E: Monte Carlo Simulate a Traffic System

8. Traffic System Software
 - Principles and Overview of Traffic System Software
 - TRANSYT7-F, CORSIM, SYNCHRO, Paramics
 - IDAS
 - Assignment F: Develop a Traffic Network Simulation

9. Applications
 - Applications to ITS
 - Other Topics TBA
 - Guest Speakers

List Of Assignments

- A. Optimize a Traffic Control. Use appropriate mathematical programming algorithms to optimize delay (or another measure of effectiveness) for an isolated intersection.
- B. Measure a Traffic Situation. Collect delay and queuing data from an actual traffic situation and summarize the results.
- C. Assign Some Traffic. Develop a network with explicit traffic controls and assign vehicles to it. Investigate the properties of the assignment.

- D. Design a System for Optimal Delay. Develop a design for a traffic system of many intersections that minimizes delay for the system as a whole. Appropriate mathematical programming algorithms should be used.
- E. Monte Carlo Simulate a Traffic System. With appropriate simulation software, develop a Monte Carlo simulation of an actual traffic situation. Check the simulation for realism.
- F. Develop a Traffic Network Simulation. Adopt a major traffic software package to simulate a system of intersections.

Grading

There will be two examinations, a midterm and a final. Students will be expected to make presentations related to their projects and handle one seminar topic. Lettered assignments will be distributed in class approximately two weeks before they are due. Grades will be weighted as follows:

Projects	45%
Midterm	20%
Final	20%
Presentations	<u>15%</u>
Total	100%