COURSE DESCRIPTION:

Catalog Description: The primary focus of this course is on the use of quantitative techniques of operations research to model system performance, design transportation services, and analyze transportation network problems through the design, analysis and implementation of algorithms. Topics include introduction to data structures, memory management and complexity analysis; queuing systems; application of graph theory and network analysis to transportation problems (including shortest path, vehicle routing and other problems arising in connection with scheduled and unscheduled systems); analytical approaches to the formulation of network equilibrium assignment problems and solution algorithms; and introduction to Intelligent Transportation Systems (ITS).

What is operations research: Operations Research (also called Management Science) is the study of scientific approaches to decision-making. Through mathematical modeling, it seeks to design, improve and operate complex systems in the best possible way. Typically, the mathematical tools used for the solution of such models are either deterministic or stochastic, depending on the nature of the system modeled. In this class, you will learn very powerful modeling and solution techniques for the class of problems we will cover. You will also gain insight about how to use these mathematical techniques in practical situations. Linear programming is the foundation of most optimization techniques that help thousands of companies save millions of dollars.

OBJECTIVE OF THE CLASS:

At the end of this class, I want every single one of you to

1) know a variety of quantitative techniques that can be used and applied to solve real life problems.
2) be able to formulate practical problems into mathematical optimization programs
3) understand how to use an algebraic modeling language and/or commercial solver to solve the mathematical programming models you write.
4) Understand the role and place of Network modeling within the realm of optimization.
5) know and understand methods and software that are appropriate for the solution of transportation queuing and network models.
6) be able to communicate with other analysts or in layman’s terms issues relative to difficult models. In particular, I want each of you to be able to gain insight about the optimal solution through sensitivity analysis.
SKILLS:

This class is also a place where you can improve some of the basic skills you will need as an engineer/or analyst. During the semester, you will need to use your
1) abstraction skills by finding ways to translate real-life problems into mathematical models,
2) teamwork skills by working in teams on a common project,
3) computing skills, by obtaining solutions of your models,
4) mathematical skills, by understanding and applying theorems,
5) analytical and reasoning skills, by analyzing the results you obtain from your models, and
6) written communication skills by writing reports for the project.

PREREQUISITES:

To be successful in this class, you need to have a good knowledge of basic mathematics including linear algebra (matrix operations) and a rudimentary knowledge of calculus. It is also assumed that you have some knowledge of the basics of mathematical programming modeling (how to form linear programs given word descriptions of problems) and are somewhat familiar with solution methodologies for linear programming (including simplex). You should have a rudimentary knowledge of GAMS (or other algebraic modeling software) and Matlab. Prerequisites: Satisfactory completion of CE 4340 or equivalent and department approval.

CLASS SCHEDULE & LOCATION:

The class meets Monday and Wednesday from 4:30pm to 5:50 pm in C302
Except
Monday March 15th to the 19th (Spring Break)
Wednesday March 31st (Cesar Chavez Day)
Friday April 2nd (Good Friday)

Final Exam is scheduled on
Monday May 10th, 4:30-6:45 pm

SECTION 2: LEARNING SUPPORT

TEACHING STAFF:

INSTRUCTOR:

Dr. Salvador Hernández
Office Hours:
Mondays: TBA
Tuesdays: TBA
Wednesdays: TBA
Thursdays: TBA
Fridays: TBA
Phone: 915-747-6834
E-mail: shernandez43@utep.edu
GETTING HELP:

My goal in this class is to give you the best possible learning experience about Operations Research and Optimization. I want you to feel free to come consult me when you have problems with the material or concern about practical aspects of the class. You can receive help in one of the following fashion:

During Class: The best moment to ask a question about something you do not understand is probably during the class. If you experience a problem, it is likely that other students experience the same problem too. However, if you do not feel comfortable asking questions in front of 50 other students, you should consider one of the following three options.

Office Hours: The instructor has weekly office hours. You can stop by anytime during these hours.

E-mail: Very often, the questions you have are brief and do not require very long answers. If this is the case, I suggest that you send your questions by E-mail. I answer E-mails typically twice a day (late morning and late afternoon).

Appointments: If it is not possible for you to come to office hours, you can schedule an appointment with me. Include in your E-mail a list of time slots throughout the week that are convenient for you. The more flexible the time slots you give, the quicker you will receive help.

You should take advantage of these four options fully. They should give you enough flexibility to get help when you need it. However, you should not stop by the instructor office unannounced. Also, you should not call the instructor at home. We will not answer any questions (even short) in such situation.

Finally when you come to office hours or to an appointment, I request that you come prepared. You should have a list of specific problems you would like me to answer. In particular, students should not come to an appointment grazing to their books in search of a question. They should not come neither with the only statement that “I do not understand anything.” Make sure to find out first what you do not understand before you come to see the instructor.

COMMUNICATIONS/ BLACKBOARD:

All communications relative to the course will be made on Blackboard. When possible, these announcements will be reiterated in class. Students are therefore responsible to check Blackboard regularly for possible updates. Syllabus and supporting material will also be available on Blackboard. In particular, slides will be available on Blackboard typically the day of the class.

TEXTBOOK:

There is no required text, however the following textbooks are recommended (they are available in the library, and for two of them online. I have a set that can be checked out for 2 hours):

Hard cover books:


Online books:


Handouts:
I will pass out some handout reading from time to time.

**SECTION 3: GETTING THE MOST OUT OF THE CLASSES**

**PREPARING FOR THE CLASS:**

Some reading material will be assigned almost every week that is relative to the use of GAMS or MATLAB. It will consist in examples of GAMS programs that will be increasingly difficult. The material covered in these class reading assignments is an integral part of the class. I chose to not include it during lectures as programming is best learned by individual exercise than by class lecture. It is crucial that you read, understand and practice this material timely as it will play a role in homework, project, midterm and exam. You can, of course, ask questions about it in class.

**ATTENDANCE:**

On-time attendance to the class is mandatory. Sign-in sheets will be distributed during the class to verify your attendance (starting the second week of the semester). You will receive attendance bonus points if your attendance exceeds 90% over the whole semester and you will receive attendance malus points if your attendance is below 60% over the whole semester. Your grade will be unaffected if your attendance is between 60% and 90%.

**SECTION 4: GETTING A GOOD GRADE**

**GRADING SCALE & PHILOSOPHY:**

You will receive numeric grades to all your assignments and evaluations. The grading scheme I use will seem unusual to most of you:

- The range 90-100 roughly corresponds to an A.
- The range 75-90 roughly corresponds to a B.
- The range 60-75 roughly corresponds to a C.
- The range 50-60 roughly corresponds to a D.
- The range 0-50 roughly corresponds to a F.

This scale applies to homework, projects and exams. In case of a particularly tough exam or homework, the grade of all students might be bumped up. Grades will never be bumped down. The grading grid used for homework, projects and exams will be communicated to you as much as
possible. These grading grids intend to be as precise as possible. However, they cannot consider all possible combinations of mistakes. Therefore, there will still be some unlisted deductions and credits.

Your final grade is based on six different sources of evaluation that are weighted differently.

1) Attendance          15%
2) Homework:    25%
3) Mid-Term1:     15%
4) Mid-Term2:    15%
5) Project:     20%
6) Presentation:    10%

Your performance in these 6 evaluation categories will primarily determine your grade in the class. Note that the only adjustments to these marks will come from your attendance bonus/malus and/or possible grade deductions for disruptive behavior. I do not hand out extra projects/homework to help students that do poorly on the tests boost their grades. Such homework and projects are unfair to the rest of the class. Do not ask.

1) HOMEWORK:

General:  Homework will be assigned roughly every two weeks. Homework will contain 6 to 9 questions. You are required to turn them all in. Solutions to all the homework sets will be posted on Blackboard. Both graded homework and solutions should be available to you at the time you submit your next homework.

Schedule:  Assigned homework will most often be due on Wednesdays. They are due at the start of class. Two weeks is a fairly long time to answer these problems. As a result, there is a strictly enforced “I do not answer questions about homework the day it is due” rule in this class. Homework is supposed to make you think about the problems. Finding its answers is a valuable exercise for you. This exercise is completely void if it is done in a rush, ten minutes before the class, by pulling the answers out of me.

Late Homework: Late homework will not be accepted. In case of serious unpredictable circumstances that can be documented (such as a hospitalization, a death of a close family member, etc.), you will not be required to turn in a homework. The final grade you obtain for the homework will therefore be determined only by the other homework you turned in. If you take part in an official school trip, you need to make sure that homework and projects get to me on time. Remember that homework may always be turned in early!

Content:  The questions will range from theoretical to practical aspects. Some will be simple applications of material seen in class, some will be challenging. Some questions will involve the use of the computer software GAMS that you are asked to learn as part of the class. Some questions will require you to code algorithms with MATLAB. Insightful, creative and original answers will earn you extra points.

Presentation:  All submitted assignments should be neat, organized and legible. If you need several pages to answer a problem, these pages should be stapled. Your name should be written on every page that starts the answer of a new problem. Homework not meeting these requirements runs the risk of being disregarded in part or even entirely.

Re-grade:  See re-grading policy below.
Academic Honesty: Ideally, every student in the class should find the answers to the problems by him/herself. Operations Research is a fairly mathematical discipline. Finding solutions by yourself testifies that you do have a good understanding of the material. Understanding the solution of somebody does not prove that you really understand the material. Be aware that the midterm and the exam will seek to evaluate your understanding of the material, not the ability to mimic the solution of some problems you have seen before. I am not against you working in groups on homework to stimulate interactions and improve your understanding of the material. If so, no written material should be exchanged between students and every student should write his/her own report. Team members should be acknowledged on the homework (this will not be used in any way to adjust your grade) and group should not be bigger than three or four students. Failing to report cooperation on homework is considered cheating.

2) PROJECT:

Students are required to work on a project to complete this class. All projects have to be performed individually. Each student will propose a project at the end of the 3rd week. Project details to be presented in class.

3) MIDTERMS:

Schedule: See course schedule

Content & Structure: TBA

Rules of the Game: You are not allowed to use your textbooks or any published material during the exam. You are not allowed to use notes or calculators neither. You are not allowed to use portable CD players, cell phones, PDAs, … during the exam. However, a one sheet (both sides) of notes can be used during the exams.

Make-Up Exams: Make-up exams will only be given under two circumstances. The first is if you are involved in an official school trip (needs to be documented) at the time the exam is scheduled. The second is that you have another exam scheduled at this time. In both of these cases students should contact the instructor so that an alternate exam schedule can be found. Make-up exams will typically take place before the regular exam is given and will be different. Students missing exams for unpredictable family or medical reasons (provided they are valid and documented) will receive as a grade for the midterm they missed the grade they will obtain on the final. If you miss more than one exam because of extreme family of medical reasons (needs to be documented), you will need to contact me to evaluate whether you should receive an incomplete. If you miss an exam for any invalid reason or if you do not provide satisfactory supporting documentation for the valid reason you invoke, you will receive an F.

GRADE/RE-GRADES:

Most likely, I will be grading all assignments and exams. I will give a grade according to a scheme that is pre-determined. You have the right to request a re-grade of any of your papers. However, you should be aware that there is a procedure and a timeline for re-grades to be considered.

Availability: Grades will only be available on Blackboard. For reasons regarding privacy protection, grades are not communicated by phone and/or e-mail.
Grading Grids: You will be provided, as much as possible, with the evaluation grid used to grade your homework, test, or final. These grids are relatively precise but cannot be completely descriptive. Therefore, there will regularly be deductions not listed on the grid since not all the mistakes possible can be envisioned when designing the grid.

When to Re-grade: Ideally, re-grades should be requested when the reasons for such re-grades are obvious (the sums of the marks you got on every part do not add up to the total you received, etc.). Be aware that if the grader misunderstood your answer during the first grading, it is probably that it was not clear. Explaining what you meant afterwards will not earn you any point. It should have been clear the first time around.

Procedure: You can ask for a re-grade every time you feel it is appropriate. You should submit in writing the reason you believe such re-grade is appropriate. This is to be done on a sheet of paper that is stapled to your original homework. The packet should then be dropped in the collection box. The grader (or me if needed) will consider these requests. No re-grade will take place on the spot nor will be considered face-to-face. The instructor and the grader keep the prerogative of deciding of a complete re-grade of the paper when you request the re-grade of any of its parts. This rule is to prevent frivolous complaints. Finally be aware that random samples of homework and tests will be photocopied and kept to verify if any alteration was made between the return of a paper and the request for a re-grade. In the case of such event, you will receive a failing grade for the totality of your homework and the case will be handed to the Dean of Students Office for prosecution.

Time Line: Every re-grade request should be entered no later than one week following the time the homework was returned to the class (if you intentionally miss three weeks of class and note later that you wanted a re-grade, it will be too late) or following the time the solutions were made available to you, whichever is latest. This clause is to insure that all grades were given fairly when the scales used by the grader and instructor are still fresh in their minds.

CHEATING:

Cheating will not be tolerated. Cheating includes, but is not limited to, looking at another student’s exam paper, bringing notes to an exam, copying somebody else’s homework, asking somebody to take an exam for you, etc. Cheaters will be confronted and will receive failing grades for every assignment/evaluation they cheated on. All cases will be handed over to the Dean of Students who will take the appropriate disciplinary measures.
CLASS SCHEDULE:

A tentative list of topics for the class is given next. This list might be shortened or lengthened depending on the pace of the class. The class time is allotted from 4:30 to 5:50 PM at C302.

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<tr>
<th>WK</th>
<th>Date</th>
<th>Topic</th>
<th>HW</th>
<th>Proj.</th>
<th>Mid Term</th>
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<tbody>
<tr>
<td>1</td>
<td>1/20</td>
<td>Course, syllabus, project introduction, Intro to O.R.</td>
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<td>2</td>
<td>1/25, 1/27</td>
<td>Mathematical programming review (Handout HW 1)</td>
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<td>3</td>
<td>2/1, 2/3</td>
<td>Mathematical programming review (Project - Problem description)</td>
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<td>4</td>
<td>2/8, 2/10</td>
<td>Introduction data structures and complexity (Handout HW 2)</td>
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<td>5</td>
<td>2/15, 2/17</td>
<td>Intro to graph theory for transportation problems</td>
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<td>6</td>
<td>2/22, 2/24</td>
<td>Shortest paths, Dijkstra's Algorithm, General labeling-correcting Algorithms (Project - Literature review)</td>
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<td>7</td>
<td>3/1, 3/3</td>
<td>Min cost flow, Network Simplex, Minimum spanning trees, (Handout HW 3)</td>
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<td>8</td>
<td>3/8, 3/10</td>
<td>Lagrangian relaxation, Multicommodity network flows</td>
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<td>3/15, 3/17</td>
<td>Spring Break- No Class</td>
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<td>10</td>
<td>3/22, 3/24</td>
<td>Network design, location (Project - Formulation and solution approach)</td>
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<td>11</td>
<td>3/29, 3/31</td>
<td>Network equilibrium and assignment (No class on 31st)</td>
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<td>Network equilibrium and assignment (Handout HW 4)</td>
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<td>4/12, 4/14</td>
<td>Queuing theory</td>
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<td>Queuing theory (Project – Results of experiments)</td>
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<td>15</td>
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<td>Introduction to Intelligent Transportation Systems (ITS)</td>
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<td>16</td>
<td>5/3, 5/5</td>
<td>Introduction to Intelligent Transportation Systems (ITS)</td>
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<td>17</td>
<td>5/10</td>
<td>Project Presentation 4:30 - 6:45</td>
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