IEE 3110: INTRODUCTION TO OPERATIONS RESEARCH

Course Syllabus

Catalog Description: The development of mathematical concepts and models concerned with industrial engineering problems. Topics include queuing theory, linear and dynamic programming. Prerequisite: IEE 2610, IEE 2620.

Credit/Contact Hrs: This is a 3 credit hour required course in the IEE Program and is scheduled for 3 contact hours/week.

Course Coordinator: Dr. Azim Houshyar

Textbook: *Introduction to Operations Research,* Hillier & Lieberman; McGraw-Hill

Software: *WinQSB v. 2.0: Decision Support Software;* Yih-Long Chang, Wiley, 2003.
Lindo Software for solving LP and IP problems; http://www.lindo.com/
EXCEL add-in Solver for solving LP and IP problems.

Evaluation: Your final grade will be based on the following:

1.	***Quiz***	***20%***
2.	***Assignment***	***10%***
3.	***Active Class Participation***	***5%***
4.	***Tests (2)***	***40%***
5.	***Final (comprehensive)***	***25%***

Grading Scale:

93 - 100	**A**	**88 - 92**	**BA**
83 - 87	**B**	**78 - 82**	**CB**
73 - 77	**C**	**68 - 72**	**DC**
60 - 67	**D**	**Below 60**	**E**

Professional Component: This course addresses ABET Criterion 4 (EAC) requirements for professional component as follows:

a) College-level math, basic science:	*0 %*
b) Engineering topics (engineering science and design):	*3 credits or 100%*
c) General education:	*0%*

Course Learning Objectives: By the end of semester the student should be able:

1. *To appropriately formulate Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems.*
2. *To appropriately formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems.*
3. *To appropriately formulate Integer Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these IP problems.*
4. *To appropriately formulate Queuing models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Queuing problems.*
5. *To interpret and apply the results of an operations research model.*
6. *To communicate the results of an operations research project through a written report and an oral presentation.*

Performance Criteria (Learning Outcomes): The student should be able to:

Course Objective 1: Formulate and solve Linear Programming Problems:

1.1. Identify a Linear Programming Problem.
1.2 Use graphical method to solve simple LP
1.3 Use Simplex Method to solve general LP
1.4 Perform Sensitivity Analysis on LP
1.5 Model and solve Transportation Problem, Transshipment Problem, and Assignment Problems.

Course Objective 2: Formulate and solve Network Problems:

2.1 Model and solve Maximum Flow Problems, Minimum Spanning Tree Problems, Shortest Path Problems, and a Minimum Cost Network Flow Problems.
2.2 Model and solve Project Networks using CPM/PERT.

Course Objective 3: Formulate and solve Integer Programming (IP) Problems:

3.1 Identify a IP Problem.
3.2 Use graphical method to solve simple IP
3.3 Use Basic Branch & Bound Method for IP Problems.

Course Objective 4: Determine performance measures for basic queuing problems using appropriate closed form equations

Course Objective 5

5.1 Work in teams to complete projects or case studies
5.2 Present brief written reports summarizing the important results and conclusions of an OR study
5.3 Present brief oral presentations.

Relationship to IEE Program Educational Objectives/Student Learning Outcomes:

This course provides significant support for the following IEE program outcomes:

Course Objectives	Performance Criteria[1]
To appropriately formulate Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems.	**E2**. Uses tools to optimize product designs.
To appropriately formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems.	**A2**. Uses appropriate engineering, science, and mathematical tools for decision making (OR, statics, materials). .
To appropriately formulate Integer Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these IP problems.	**A2**. Uses appropriate engineering, science, and mathematical tools for decision making (OR, statics, materials). .
To appropriately formulate Queuing models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Queuing problems.	**A2**. Uses appropriate engineering, science, and mathematical tools for decision making (OR, statics, materials).
To interpret and apply the results of an operations research model.	**A2**. Uses appropriate engineering, science, and mathematical tools for decision making (OR, statics, materials).
To communicate the results of an operations research project through a written report and an oral presentation.	**G3**. Presents information in writing that is well-organized, addresses objectives, and meets required standards of grammar and language rules.

Attendance Policy:

Attendance is not mandatory. But, student will receive a score of zero for any assessment item not submitted because of absence -this includes the assignments, tests, and the final exam. Extreme circumstances will be considered on an individual basis, however, when possible arrangements must be made prior to the due date, and supporting documentation is necessary. Moreover, you are expected to actively participate in the discussion. Please note that you will be graded on your participation, so don't keep quiet!

Academic Honesty Policy:

The Faculty Senate's Professional Concerns Committee recommends all instructors include the following paragraph in each syllabus they prepare.

"You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test."

You are also directed to: http://osc.wmich.edu and www.wmich.edu/registrar to access the Code of Honor and general academic policies on such issues as diversity, religious observance, student disabilities, etc.

Expectation during lecture:

- You ARE expected to be in class at the start time. No late arrival will be tolerated.
- The class is being held in the computer lab, so we can use computer software to solve problems. You MAY NOT use the computer to read your e-mails, news, etc.
- You MAY NOT ask questions from your fellow students. However, you are encouraged to ask any questions from the instructor.
- You MUST turn your cells phones off.

Homework:

Recommended homework problems will be given in class. These problems are recommended and will be collected when announced in class. At the end of semester, I will ask for your homework note-book, and will review them for completeness. Your grade for active participation will be affected by incomplete assignment submission. At times, I may choose to grade only a few of the submitted homework (i.e., you submit your solution to ten problems, and I only grade one of those ten problems). In such case, your grade will be based on the ones that I actually grade. You are encouraged to work these problems to help you learn the material.

You are welcome to solve any problem using software, unless I have specified otherwise. If you use software to solve a problem you must submit sufficient documentation to illustrate your approach to the problem, along with the appropriate output to justify your results.

Quiz:

Starting with the second week, every week there will be an unannounced 10-20-minute quiz on the subject matter covered in the previous session. Therefore, you are responsible for the material up to the day of the quiz. During each quiz you are allowed to have a calculator, but no cell phones or laptops are allowed.

Tests:

The tests will be administered during the lecture period on the days indicated in the schedule. You are responsible for the material up to the day of the test. During each test you are allowed to have a calculator, but no cell phones or laptops are allowed.

Topics and Schedule:

The test and final exam times will occur on the dates listed, however, content of the tests may be altered based on the material covered prior to test time.

Week	Topics	Chapter/Section
1	Introduction to Operations Research	1.1 - 1.4
	OR Modeling Approach	2.1 - 2.7
2	Introduction to Linear Programming	3.1 - 3.2
	LP Assumptions & Examples	3.3 - 3.5
	Solving LP's with Software	3.6 - 3.8
3	Introduction to the Simplex Method	4.1-4.6
4	Introduction to the Simplex Method	4.1-4.6
5	The Essence of Duality Theory	6.1
	Economic Interpretation of Duality	6.2
6t	Primal-Dual Relationships	6.3 - 6.4
	Sensitivity Analysis	6.5 - 6.8
	TEST 1	
7	Transportation Problem	8.1-8.2
	Assignment Problem	8.3 - 8.4
8	Networks & Shortest Path	9.1 - 9.3
	Minimum Spanning Tree	9.4
9	Maximum Flow	9.5
	Minimum Cost Network Flow	9.6
10	Project Planning CPM/PERT	9.8
11	Integer Programming	11.1 -11.2
	TEST 2	
12	Integer Programming	11.3 -11.6
13	Queueing Theory	17.1 - 17.5
14	Queueing Theory	17.6 - 17.9
15	***FINAL EXAM***	