IENG 350 (Section 002)
Introduction to Operations Research

Fall 2018

Instructor:	A. McKendall, Ph.D.	Credit hours:	3
	Associate Professor, IMSE Department	Class Time:	10 – 10:50 a.m., MWF
Office:	321 Engineering Sciences Building	Room:	MRB-E 113
Email:	armckendall@mix.wvu.edu	Office hours:	11 – 11:50 a.m., MWF;
Phone:	304-293-9472		or by appointment

Course Description: An introduction to basic principles and techniques of operations research. Topics include linear programming, integer programming, transportation and assignment problems, project scheduling, queueing theory, and computer applications.

Prerequisite: IENG 213

Textbook: Operations Research – An Introduction, Ninth Edition, by H.A. Taha, Prentice Hall, NJ, 2011.

Grading:	Exam 1	25%
	Exam 2	25%
	Final Exam	25% (Thurs., Dec. 13th, 2 – 4 p.m.)
	Quizzes/Attendance/Class Participation	20% (every other second or third Fri.)
	Attendance/Class Participation	05%
		100%

Tentative Grading Scale:	90 – 100 A
	80 – 89 B
	70 – 79 C
	60 – 69 D
	0 – 59 F

Students in Class Must Be Registered: All persons attending class must be registered for the current semester as either a regular student or for audit. Students are not allowed to sit in or participate in class if they are not registered. Similarly, **students are not allowed to sit in or take quizzes and exams in another section of the same course**. **No exceptions!**

Electronic Devices: Cell phones or any other electronic devices must be **turned off and put away** during class, exams, and quizzes.

Academic Dishonesty: Cheating during any of the exams or quizzes will result in a failing grade (a grade of zero) on that exam or quiz and will be reported. Other acts of academic dishonesty could result in an "**Unforgivable Failure of the Course**." See following website for details (https://provost.wvu.edu/governance/academic-standards-resources).

Homework Assignments: Weekly homework assignments will be given to re-enforce your understanding of the concepts and tools presented in class as well as to prepare you for quizzes and exams. However, homework assignments will **neither be collected nor graded**.

Quizzes: Quizzes will be given either during the first or last 15-25 minutes of class every other second or third Friday, except during exam week. At the end of the semester, your lowest quiz score will be dropped. **Make-up quizzes will not be given**. If you are absent and miss a quiz or arrive late to class, you will receive a score of zero, and this quiz (your lowest quiz score) will be dropped. All quizzes will be **closed book**, **closed notes**, **no calculators**, and **remove smart watches**.

Exams: All examinations will be **closed book** and **closed notes**. Also, **calculators (or smart watches) will not be permitted** to complete the exams and should be put away. All work must be shown in order to receive full credit, and instructions should be followed in order to avoid point deductions. There will be **no makeup exams**. However, if you miss one of the first two exams due to serious illness (documented) or serious family emergency (documented), then you will take a **cumulative final exam**. More specifically, if a student miss an exam, the student must email me explaining why they will miss (or have missed) the exam within 24 hours before (or after the exam). There is no makeup (cumulative final) exam without a proper and certified excuse (sent to me via email). The regular final exam will be a 1-hour exam covering the most recent topics. In contrast, the **cumulative final exam** will be a 2-hour exam covering all topics. If you miss the first two exams, you will receive a zero on one of the exams and will need to take the cumulative final exam to make up for the other one. If you miss only the final exam, you will be required to take the cumulative final exam.

Statement on Attendance: "Student **attendance contributes significantly to academic success" and is mandatory**. "**Students are responsible for making instructors aware of anticipated absences due to Authorized University Activities as soon as possible** to help facilitate the make-up process. Students **must provide instructors a copy of the University documentation** for the anticipated absences from class. Students are also encouraged to meet with their instructors at the beginning of the semester to discuss these anticipated absences. **Students who fail to inform their instructors of their absence prior to participation in a University Authorized Activity shall not be excused for that absence by the instructor**. Students who know that they will be **absent for more than 15% of class time** are **strongly encouraged to take the course at some other time** when they will not be absent to this degree. Students who are absent from class for any reason are **responsible for all missed work**." In other words, if an emergency arises that require an absence from a class, it is **the students' responsibility to get the notes and all other information that was covered in class from a fellow student**. In deciding whether to attend class, please do not ask the instructor if he will be covering anything important that day. The course is carefully planned out, and every lecture is important.

Statement on Student Behavior in the Classroom: The behavior of each person in class in some way or the other affects the learning environment. If we are mindful of disruptive behavior, the classroom experience will be a better one for everyone involved. The following behaviors are defined as disruptive.

1) **Entering class late or leaving class early** is disruptive. If you arrive in class late, just slip in as quietly as possible so as not to disrupt others. Also, **if you come to class after a quiz/exam has already been passed back**, please do not ask for your quiz/exam until after the class is over.

2) **Ringing cell phones, text messaging, and using other electronic devices** are disrespectful to others in the class and are disruptive to the learning environment.
3) **Conversing with other students** in class while professor or other students are presenting information or expressing their viewpoints is disruptive to others and will not be tolerated. Also, **using profanity, ridiculing others, and not respecting the rights of other students** will not be tolerated.
Disruptive students will be **warned** and will possibly be **reseated**. After a warning, the disruptive students will be asked to **leave the classroom**. If continued, the disruptive students will be dealt with accordingly.

Social Justice Statement: West Virginia is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

Accommodations: If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, you must make appropriate arrangements through Disability Services (304-293-6700).

Successful Strategies:
1) Attend all classes.
2) Not only attend classes, but during lectures make sure you understand course material. Asks questions, when material is unclear.
3) Participate in classroom discussions by answering instructor's questions.
4) After each class, rewrite and review notes, and redo example problems worked out during lecture.
5) Do all homework assignments as soon as they are assigned to re-enforce your understanding of the course material.

Course Topics:
1. Introduction to Operations Research – (1 week)
   Overview of Operations Research (**Chapter 1**).
2. Linear Programming (LP) – (5 weeks)
   Formulations (**Section 2.1 & 2.4**),
   Solution Techniques – Graphical Method (**Section 2.2**), Algebraic Method (**Sections 3.1-3.2**), Simplex Method and Solution Types: Unique, Unbounded, Multiple, Degenerate, and Infeasible Solutions (**Sections 3.3-3.5**).
   Duality and Sensitivity Analysis – Dual Problems and Solutions (**Sections 4.1-4.3**), Sensitivity Analysis (**Section 3.6**).
   Computer Applications – Solving LP models using Microsoft Excel (**Section 2.3.1**).
3. Special Types of Linear Programming Models (Network Models) – (3 weeks)
   Transportation Problems – Formulations, Obtaining Initial Solutions, and Transportation Algorithm (**Sections 5.1-5.3**).
   Assignment Problem – Formulations and Hungarian Algorithm (**Section 5.4**).
   Other Network Models – Transshipment Model (**22.15-17**), Minimum Flow Cost Model (**handout**), Shortest-Route Problem (**Section 6.3**), and Maximal Flow Problem (**Section 6.4**).

Computer Applications – Solving LP models using MPL Modeling System with CPLEX Solver). *This material is not covered in textbook* (**handout**).

4. Integer/Mixed Integer Linear Programming (ILP, MILP) – (3.5 weeks)
   Formulations (**Chapter 9 and notes**).
   Traveling Salesperson Problem (TSP) – Applications, Model, Solution (**Sections 11.1-11.2**).
   Other Problems/Models – Knapsack Problem, Vehicle Routing Problem, etc. (**handout**).
5. Queueing Theory – (2 weeks)
   Simple Queueing Models (**Sections 18.1 – 18.3** and **handout**).

Course Goals:

1. To provide students with techniques for formulating operations research problems they may encounter in industry.
2. To provide students with solution techniques for solving operations research problems.
3. To teach students how to analyze and interpret the solutions obtained from solving operations research problems.

Student Learning Objectives:

Upon completing the course, the student will be able to:

1. Formulate and solve linear programming problems using exact methods and practical software.
2. Study the dynamic behavior of the optimal solution of a linear programming problem (i.e., determine how the optimal solution changes as the problem parameters change) by using sensitivity analysis and interpret solution.
3. Formulate simple integer programming problems and solve integer programming problems using commercial software.
4. Manage and control projects using PERT-CPM method.
5. Study and analyze basic queueing models.

Course Contribution to Professional Component:

Engineering Science – 70%, Engineering Design – 30%

Course Relationship to Program Educational Outcomes:

The course relates strongly to the following program educational outcomes.

1. The course enables the students to acquire the ability to use modern and classical industrial engineering methodologies pertaining to operations research (Outcome 1). The key abilities the students will acquire are as follows:
   a. Linear programming
   b. Project Management
   c. Queueing Theory
   d. Transportation & Assignment Problems

2. The course enables the students to acquire the ability to work individually and on teams to formulate and solve operations research problems (Outcome 4). The key abilities the students will acquire are as follows:
   a. Identify, formulate, and solve problems.

Prepared By: A. McKendall, Ph.D. **Date**: August 10, 2018