IENG 554
Applied Integer and Heuristic Programming

Fall 2019

Instructor:	A. McKendall, Ph.D.	Credit hours:	3
	Associate Professor, IMSE Department	Class:	1 – 1:50 p.m., MWF
Office:	321 Engineering Sciences Building	Room:	109 MRB-E
Email:	armckendall@mix.wvu.edu	Office hours:	2 – 2:50 p.m., MWF
Phone:	304-293-9472		or by appointment

Course Description: Applications of integer and heuristic programming techniques for solving combinatorial optimization problems. Topics include computational complexity, relaxations, branch and bound, cutting planes, simulated annealing, tabu search, and genetic algorithms.

Prerequisites: IENG 350 or 553 and knowledge of a computer programming language.

Textbook: Wolsey, L.A., *Integer Programming*, John Wiley & Sons, 1998, ISBN: 0471283665.

Grading:	Midterm Exam	25%
	Final Exam	25% (Tues., Dec. 17th, 11 – 1 p.m.)
	Projects	25%
	HW Assignments	25%
		100%

Tentative Grading Scale:
90 – 100 A
89 – 80 B
79 – 70 C
69 – 60 D
Below 60 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.

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).

Exams: All examinations will be **closed book** and **closed notes**. Also, **calculators will not be permitted** to complete the exams. 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 you miss an exam, you must email me explaining why you 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. The regular final exam will be a 2-hour exam covering the most recent topics. In contrast, the **cumulative final exam** will be a 3-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.

Assignments: Assignments will be given periodically throughout the semester which may be collected and graded. You may be required to use **Matlab** or **MPL/CPLEX** to complete the assignments.

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 and provide official documentation 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.

Classroom Behavior: Cell phones or other electronic devices must be **turned off and put away** during class. Attend to any personal needs (restroom, phone calls, etc.) prior to class time.

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).

Tentative Course Topics (may not be taught in this order)
1) Review of Linear Programming Models.
2) Transformation of Nonlinear Programming Models to Linear Programming Models.
3) Some Common Integer Programming Models.
4) Bounds and Relaxations (Linear and Lagrangean).
5) Integer Linear Programming Techniques (Exact Methods): Complete Enumeration, Partial Enumeration (Branch and Bound), and Cutting Planes.
6) Modeling and Solving Integer Programming Models using Microsoft Excel and MPL/CPLEX.
7) Computational Complexity.
8) Combinatorial Optimization Problems and their Formulations.
9) Heuristics (e.g., Lagrangean Heuristics, Exchange, Add/Drop).
10) Meta-heuristics (e.g., Simulated Annealing, Tabu Search, Genetic Algorithms).
11) Testing the Performance of a Heuristic.
12) Other Topics (e.g., Decomposition, Ant Systems, Other Meta-heuristics) if time permits.

Student Learning Objectives:
Upon completing the course, the student will be able to:
1) Formulate and solve simple integer programming/combinatorial optimization problems using exact integer programming techniques and practical software.
2) Understand how to use a modeling language and a commercial solver to solve and analyze integer linear programming problems.
3) Understand the computational complexity of solving large-scale combinatorial optimization problems.
4) Understand the strengths and weaknesses as well as how to apply meta-heuristics for solving large-scale combinatorial optimization problems.
5) Develop efficient heuristic (or approximation) techniques for solving large-scale combinatorial optimization problems encountered in the real world.

Prepared By: A. McKendall Date: August 20, 2019