

# CSCI 8460 SYLLABUS    INTEGER PROGRAMMING

## 1.0    COURSE DESCRIPTION

- 1.1    Overview of content and purpose of the course  
Advanced study in mathematical programming with integer or mixed integer variables. Topics include: Integer programming, model creation, developing solution algorithms, and the applications of integer programming.
- 1.2    For whom the course is intended  
The course is intended not only for mathematics students but also for students from any technical area who would like to improve their ability and knowledge in modern decision making.
- 1.3    Prerequisites of the course  
MATH 2030 or 2230
- 1.4    Unusual circumstances of the course  
This course has a very flexible nature which can be directed to many areas of modern applied sciences.

## 2.0    OBJECTIVES

- 2.1    Students will become familiar with modern discrete decision making and be able to develop the model and the solution algorithm. In particular, the elementary integer program solution methods, such as the set covering problems, knapsack problems, and their variations.
- 2.2    Understand the new concepts of optimality, familiar with modern evolutionary algorithms
- 2.3    Apply the computation ability of modern computers, and hence develop efficient and applicable heuristic algorithm.

## 3.0    CONTENT AND ORGANIZATION

- 3.1    Creating Integer Programming Models
  - a.)    Model categories
  - b.)    Formulating IP and MIP models
  - c.)    Real-world case studies
- 3.2    Integer Programming Algorithms
  - a.)    Review of linear programming
  - b.)    Cutting-plane methods
  - c.)    Branch-and-bound, branch-and-cut methods
  - d.)    Heuristics and meta-heuristics: greedy, GRASP, genetic algorithms, Tabu search

- 3.3 Integer Programming Applications  
Solving Knapsack Problem, Set Covering Problems, Traveling Salesman Problem and Fixed Charge Problems.

**4.0 TEACHING METHODOLOGY:**

- 4.1 The lecture method will be used to initiate the topics discussion.
- 4.2 Students are encouraged to participate in the discussion and/or to ask questions and generally to take as much initiative as possible.

**5.0 EVALUATION- BASIS FOR DETERMINING FINAL GRADE**

- 5.1 In class tests will be given at least two times before the final examination and a comprehensive final examination will be given during the final exam week.
- 5.2 Take home assignments will be given during each meeting. The assignments will be collected at the beginning of the next meeting right after the assignment is given. The assignment will be graded.
- 5.3 A term paper and presentation are expected from every student before the end of the semester.
- 5.4 The student’s grade will be evaluated based on items 5.1, 5.2, and 5.3 above. The percentage contribution of each of these items will be announced on the first day of the class. The following is a typical example for grading.

Test 1	Test 2	Final Exam	Take home assignment	Project (term paper)	Presentation	Total
10%	10%	30%	25%	15%	10%	100%

- 5.5 Grading Scale  
The grading scale will be given to the students on the first day of class. Plus or minus grades to be used at the discretion of the instructor. Below is a sample grading scale:

A = 90-100                      D = 60-69  
 B = 80-89                      F = Below 60  
 C = 70-79

**6.0 RESOURCE MATERIAL**

- 6.1 TEXT  
*Foundations of Integer Programming*, by Salkin, H.M. and Mathur, K., North Hollard, 1989.

## 6.2 REFERENCES

1. Schrijver, A., *Theory of Linear and Integer Programming*, Wiley, 1986.
2. Christodoulos A. Floudas, *Nonlinear and Mixed-integer Optimization: Fundamentals and Applications*, New York, Oxford, 1995.
3. Hu, T.C., *Combinatorial Algorithms*, Addison-Wesley, Reading, MA.
4. Cook, W.J., W.H. Cunningham, W.R. Pulleyblank and A. Schrijver, A., *Combinatorial Optimization*, Wiley, 1998.
5. Matello S., P. Toth, *Knapsack Problems*, Wiley, 1990.
6. Kaplan, W., *Maxima and Minima with Applications: Practical Optimization and Duality*, New York, Wiley, c1999
7. Nemhauser, George L., Laurence A. Wolsey, *Integer and Combinatorial Optimization*, New York, Wiley, c1988
8. Lay, Louis, Teo; editor-in-chief, Peter L. Hamme, *Optimization Theory and Its Application*, Boston, MA. : Kluwer Academic Publishers, c2001