Department of Mathematical Sciences
Carnegie Mellon University

21-393 Operations Research II
Test 1

Name:_____

Problem	Points	Score
1	35	
2	35	
3	30	
Total	100	

Q1: (35pts)
A factory produces a single product over the next n periods. The demand in period i is $d_i, i = 1, 2, \ldots, n$ and must be met immediately. The cost of producing x items on a machine of age t is $c_t(x)$. The cost of repairing a machine age t so that it performs as well as a machine aged s is $r(t, s)$. A machine aged T or more must be replaced at a cost of R. The maximum amount that can be held in stock from one period to the next is H. Construct a recurrence that can be used to solve the problem of meeting demand at minimum total cost.

Q2: (35pts)

Formulate the following as an integer program: A university has n rooms available and there are $2n$ classes $M_1, M_2, \ldots, M_n$ and $A_1, A_2, \ldots, A_n$ where $M_1, M_2, \ldots, M_n$ and $A_1, A_2, \ldots, A_n$ are both partitions of the set of students S. The classes M_i will take place in the morning and the classes A_i will take place in the afternoon. The distance between classroom k and classroom ℓ is $d_{k,\ell}$. The problem is to assign classes to rooms in order to minimize the total distance travelled by students in changing classes.

(Hint: let $y_{i,k,j,\ell} = 1$ iff M_i takes place in room k and A_j takes place in room ℓ. It will help you to use the notation $m_{i,j} = |M_i \cap A_j|$.)

Q3: (30pts)
The simplex algorithm applied to the LP relaxation of a pure integer program results in the following tableau:

x_1	x_2	x_3	x_4	R.H.S.	
-3/2	0	-5/2	0	17/2	z
-5/2	0	3/2	1	7/2	x_4
-1/2	1	1/2	0	5/2	x_2

Finish the solution of the Integer Program using Gomory cuts. What is the optimal solution?
(One cut and one further pivot should suffice.)