Department of Mathematics
Carnegie Mellon University

21-393 Operatons Research II
Test 2

Name:________________________________

Problem	Points	Score
1	10	
2	30	
3	30	
4	30	
Total	100	

Q1: (10pts)
Find a minimum length spanning tree in the graph below:

Q2: (30pts) Carry out one complete iteration of a branch and bound algorithm to solve the Travelling Salesman Problem with the cost matrix below i.e. compute a lower bound, choose a variable to branch on and then compute bounds for the two sub-problems you create.

DO NOT ATTEMPT TO SOLVE THE COMPLETE PROBLEM

$$\begin{bmatrix} \infty & 6 & 4 & 3 & 2 \\ 4 & \infty & 2 & 5 & 3 \\ 3 & 7 & \infty & 4 & 6 \\ 2 & 4 & 3 & \infty & 4 \\ 3 & 4 & 3 & 6 & \infty \end{bmatrix}$$

Q3: (30pts) Solve the assignment problem with the matrix below:

$$\begin{bmatrix} 6 & 4 & 3 & 2 \\ 4 & 2 & 5 & 3 \\ 3 & 7 & 4 & 6 \\ 3 & 4 & 4 & 6 \end{bmatrix}$$

Q4: (30pts) During any year I can consume any amount that does not exceed my current wealth. If I consume \$c during a year then I earn c^a units of happiness. By the beginning of the next year, the previous years ending wealth grows by a factor α.

(a) Formulate a recursion that can be used to maximise the total happiness earned during the next T years. Assume that I originally have \$$w_0$.

For a possible bonus of 30pts:

(b) Let $f_t(w)$ be the maximum happiness earned during years $t, t+1, \dots T$, given that I have \$$w$ at the beginning of year t and that $c_t(w)$ is the amount that should be consumed during year t to attain $f_t(w)$. By working backwards from T show that for appropriately chosen constants a_t and b_t,

$$f_t(w) = b_t w^a \text{ and } c_t(w) = a_t w.$$