Name ____________________

Interconnection Networks
EE 7725
Midterm Examination 1.5

16 November 1994, 13:40-14:30 C. S. T.

Problem 1	______	(30 pts)
Problem 2	______	(30 pts)
Problem 3	______	(40 pts)
Exam Total	______	(100 pts)

Good Luck!

Problem 1: What is the crosspoint graph model for k-ary n-cube networks with $k > 2$? Include the processors as input and output nodes. Assume that links and crosspoints can carry signals in only one direction. Include only necessary crosspoints. (30 pts)

Problem 2: An $(n, m, m^{n-1}, \mathrm{S}, \mathrm{T})$ interconnection network is offered the following hot traffic. The probability of a packet arriving at an input in a cycle is λ. With probability h the packet will be directed to the hot output, $H \in \langle n^m \rangle$. With probability $1 - h$ the packet will be directed towards an output randomly chosen, with a uniform distribution, from $\langle n^m \rangle$. (This is the hot traffic model used in describing combining networks.)

Assuming that all packets enter the network, what will the flow rate (expected number of packets per cycle) be through queue 0 in stage x, cell i? (The queue connected to link i is called queue $i \bmod m$.)(30 pts)

Problem 3: Answer all of the questions below. Be as brief and as specific as possible.

(a) Find the minimum-cost N-input omega network when the cost of crosspoints is zero and the cost of each link is one. (16 pts)

(b) Packets arrive at a queue at rate λ packets per cycle. They are serviced at rate μ packets per cycle. A packet arriving at a full queue is dropped. What is the probability that this will happen, in terms of λ and μ? (See Note Set 3). (12 pts)

(c) Based on the performance model presented early in the semester (see Note Set 1), find an expression for the maximum rate at which processors would send messages in a N-processor parallel computer running a parallel program consisting of P tasks. The processor utilization is one; the network delay is $\sqrt{N}$. The answer should be in terms of N and P. (12 pts)