EECS 863  
Homework

1. A leaky bucket flow control scheme works at the entry point of the network to regulate the offered traffic. Packets arriving to the leaky bucket must wait in a queue for a permit before entering the network. Permits are generated independently from the offered traffic. Thus upon arrival a packet will be sent if a permit is available otherwise it waits in the buffer for the arrival of a permit. Permits arriving to a system with no packets ready for transmission will be saved in a queue. The permit queue is limited to $W$ permits. A permit is discarded if it arrives when the permit queue is full. For this problem assume that packets arrive to the system according to a Poisson process at a rate $\lambda$. Also assume that the permits arrive according to a Poisson process at a rate $\mu$. Let $W=4$ for this problem.
   a) Find the steady-state probability mass function for the number of packets waiting to be transmitted.
   b) Find the steady-state probability mass function for the number of permits.  
      [Hint: use a M/M/1 formulation with a careful definition of the states.]

2. A Markovian queueing system with discouraged arrival can be modeled with the following state dependent arrival and departure rates:

   \[ \mu(n) = \mu \]
   \[ \lambda(n) = \frac{\lambda}{n + 1} \]

   a) Draw the state transition diagram.
   b) Write the state probabilities, $p(n)$ as a function of $\mu$, $\lambda$, and $p(0)$.
   c) Find a closed form solution for $p(0)$.  
