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 l. Also assume that the permits arrive according to a Poisson process at a rate μ. 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 μ, λ, and p(0).
c) Find a closed form solution for p(0).

3. Consider a Continuous Time Markov chain with state space S = {0, 1, 2} with $\lambda_0 = \lambda_1 = 1$ and $\mu_1 = 1$, $\mu_2 = 2$

a. Find π_j j = 1, 2, 3, using the Q matrix
b. Mapping States into number of customers in the system as follows,
State 1=Empty
State 2=One customer in the system
State 3= Two customers in the system
Find the average number of customers in the system.
c. Find the probability the system is full.