# EE 679, Queueing Systems (2001-02F)
# Test -1, Aug 24, 2001

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**Max. Marks = 25** **Time = 60 minutes**
**Attempt both problems**

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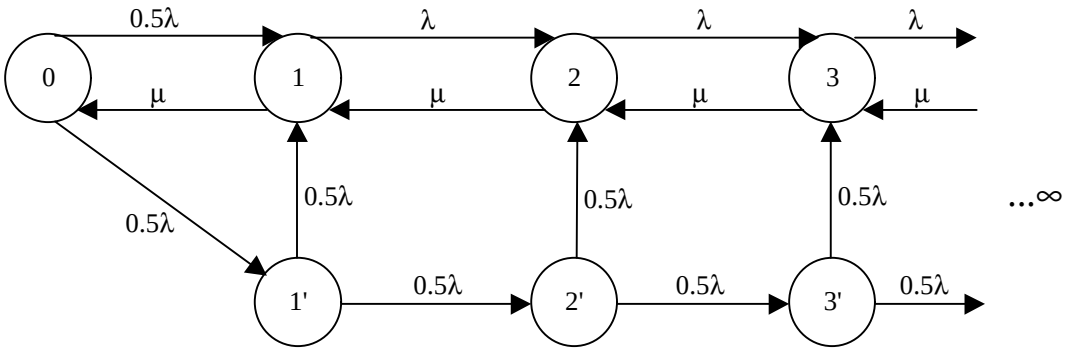
**1.** Following the same approach as discussed in class for the simple M/M/1/∞ queue, we want to do the equilibrium analysis of the M/M/1/K queue (Poisson Arrivals, Exponential Service Times, Single Server, Maximum of K users in system). Assume that the arrivals come at rate $l$ and that the mean service time is $\frac{1}{m}$. Define $r = \frac{l}{m}$ and obtain the following. (You can write the balance equations directly, if you wish.)

a) The state probabilities $p_n$ for $n=0,1,2.....,K$ (Note that $n$ is the number in the system.) [6]
b) The mean number in the system [5]
c) The probability that an arrival will leave without service [2]
d) When will the system have an equilibrium solution? Justify your answer with an appropriate statement. (No proof is required.) [2]

**2.** The state transition diagram for a continuous time Markov chain is given below where $l$ is the arrival rate and $m$ is the service rate.




Solve this system to obtain its equilibrium state probabilities stating the condition (if any) under which such a solution will exist.
[Note that the state probabilities will have to be found for all states 0, 1, 1', 2, 2' .....∞. You should find $p_0$ and $p_{n'}$ explicitly and at least give expressions which may be evaluated for $p_n$.]

[8+2]