

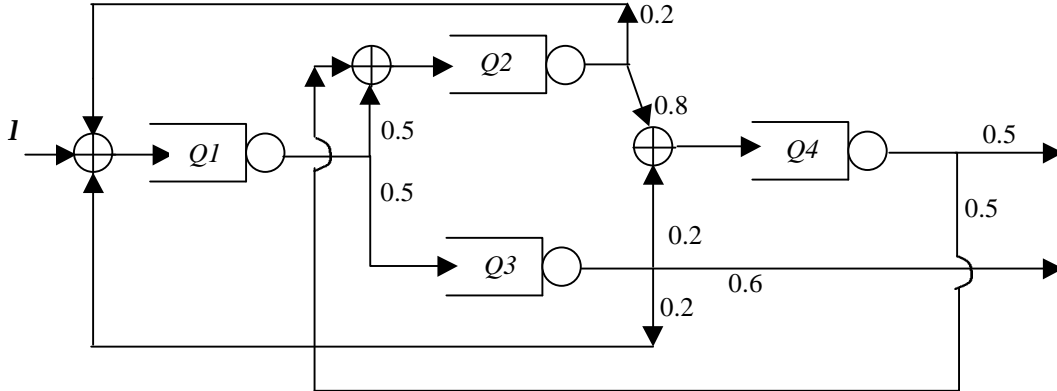
## EE 679, Queuing Systems (2001-02F) Test -6, November 24, 2001

**Max. Marks = 25**

**Time = 60 minutes**

**Attempt all problems**

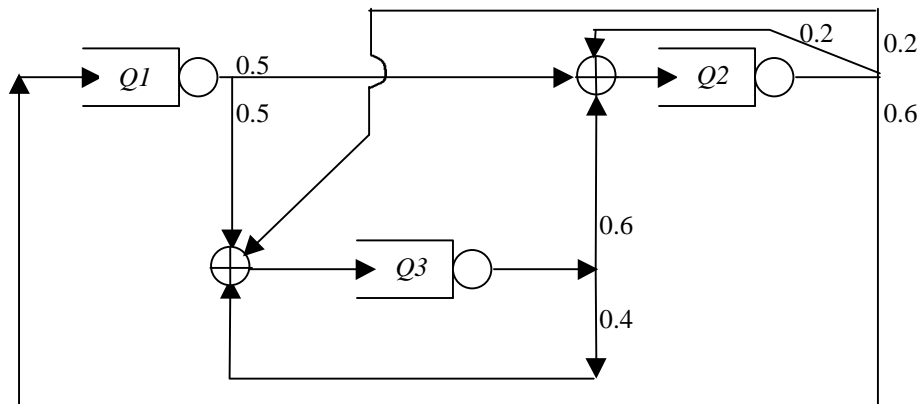
1. Consider the following open network of  $M/M/1$  type FCFS queues.



The external arrivals are at  $Q1$  from a Poisson process with average arrival rate  $I$ . The mean service rates are  $m_1 = m_2 = m$  and  $m_3 = m_4 = 0.5m$

- (a) What will be the maximum value of  $I$  for which the system will be stable? [2]
- Do the following for  $I=0.1$  and  $m=1$**
- (b) Give the state distribution of the system. [2]
- (c) Give the mean number in each queue. [2]
- (d) Give the mean time spent in system by a customer entering the system. [2]

2. Consider the closed queuing network of single server queues with exponentially distributed service times, as shown in the figure below.



The average service rates of  $Q1$ ,  $Q2$  and  $Q3$  are respectively  $m_1 = 0.5$ ,  $m_2 = 1$ , and  $m_3 = 0.5$ .

- (a) If the system has a total user population of 3, **use the MVA approach** to obtain the mean number  $N_i$  for each queue  $Q_i$   $i=1, 2, 3$  [9]
- (b) Consider the same system with  $M$  users where  $M$  is very large. How will the  $M$  users be distributed between the three queues? [8]