EXERCISE 1: Let's assume that 50 terminals are connected to a terminal concentrator. Each terminal transmits packets with a size exponential distributed with an average $m = E[M]$ (information plus control) equal to 1000 bits. All packets, collected by the terminal concentrator, are transmitted on an output link of capacity equal to C bit/sec. Packets are transmitted by terminals with a rate which depends on the terminal, i.e.

- 25 terminals are characterized by a transmission rate of 1 packet/10 seconds each;
- 25 terminals are characterized by a transmission rate of 1 packet/5 seconds each.

Let's further assume that for each terminal of the above two groups the packet arrival process at the concentrator be Poissonian. Complete the following tasks:

1. calculate the value of C so as the average number of packets in the system be equal to 5;
2. determine the value of C, hereafter called $\tilde{C}$, so as the 99-th percentile of packets in the system be equal to 5;
3. repeat the same calculation of point 1 above for packets of a constant size of 1000 bits;
4. calculate the 99th percentile of the waiting time distribution and system response time distribution under the assumption that the concentrator is modelled with an M/M/1 queuing system.

By assuming that the rate of the output transmission line of the terminal concentrator be $\tilde{C}$ and that the concentrator is modelled with an M/M/1/K queuing system with $K = 5$:

5. calculate both the packet loss probability (P_L) and the throughput.