UNIVERSITAT POMPEU FABRA

# Quality of Service
**Seminar 4**

Date: Spring
Duration: 15 min.

- There is only one correct answer for each multiple choice question.
- Each correct answer adds 1 point.
- Each incorrect answer has a penalty of $\frac{1}{3}$ points.
- No score is awarded for unanswered questions, neither positive nor negative.
- Mark out your answers with an "X".
- No score is awarded if you mark more than one answer.

Write your personal data clearly.

| | |
|---|---|
| Last name: | |
| First name: | |
| Group: | |

**Permutation:** A

**NIA**: | | | | | | | | | |

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |

1.- A packet queue has a random early discard dropper. If the system is empty, it accepts all the packets. If there is one packet, it drops 25 % of the incoming packets. If there are two packets in the buffer, 50 % of the incoming packets are dropped. If there are three packets, 75 %. If there are four packets, it drops all the incoming packets. Packets arrive following a Poisson arrival and the average interarrival time is 3 ms. Service time is exponentially distributed, with an average of 3 ms. Determine the average number of packets in the system.

(a) $0 < N \leq 1$.
(b) $3 < N \leq 4$.
(c) $4 < N \leq 5$.
(d) $1 < N \leq 2$.

2.- Consider a router with exponential service time and a serving rate of 100,000 packets per second. The Poisson arrival rate is 90000 packets per second. How many times does the router move to the idle state every second (on average)?

(a) $10^4 < T \leq 10^6$.
(b) $10^2 < T \leq 10^4$.
(c) $10^6 < T$ .
(d) $0 < T \leq 10^2$.

3.- A packet queue has a random early discard dropper. If the system is empty, it accepts all the packets. If there is one packet, it drops 25 % of the incoming packets. If there are two packets in the buffer, 50 % of the incoming packets are dropped. If there are three packets, 75 %. If there are four packets, it drops all the incoming packets. Packets arrive following a Poisson arrival and the average interarrival time is 3 ms. Service time is exponentially distributed, with an average of 3 ms. Determine the fraction of time that the system is empty.

(a) $0{,}5 < p_0 \leq 0{,}75$.
(b) $0 < p_0 \leq 0{,}25$.
(c) $0{,}75 < p_0 \leq 1$.
(d) $0{,}25 < p_0 \leq 0{,}5$.

4.- The packet arrival rate of high priority traffic is 1000 packets per second and the arrival rate of low priority traffic is 99000 packets per second. Both arrival processes are Poisson and strict preemptive priority is used. If the service rate is 200000 packets per second and the service time distribution is exponential, what is the fraction of time that there is at least one high priority packet in the system?

(a) $0 \leq \phi < \frac{1}{8}$
(b) $\frac{1}{4} \leq \phi < \frac{1}{2}$
(c) $\frac{1}{8} \leq \phi < \frac{1}{4}$
(d) $\frac{1}{2} \leq \phi \leq 1$

5.- A packet queue has a random early discard dropper. If the system is empty, it accepts all the packets. If there is one packet, it drops 25 % of the incoming packets. If there are two packets in the system, 50 % of the incoming packets are dropped. If there are three packets, 75 %. If there are four packets, it drops all the incoming packets. Packets arrive following a Poisson arrival process and the average interarrival time is 3 ms. Service time is exponentially distributed, with an average of 3 ms. Determine the mean sojourn time of the accepted packets in ms.

(a) $6 < T \leq 7$.

(b) $3 < T \leq 4$.

(c) $4 < T \leq 5$.

(d) $5 < T \leq 6$.

6.- The consumption of the communications module of a sensor node is related to the transmit rate and the number of packets in the module (including the one that is being transmitted). In particular it consumes one joule for each packet per second that it can transmit and another joule each second for each packet in the system. Assuming that the service time is exponential, find the service rate that minimizes energy consumption for a packet arrival rate of 1 packet per second.

(a) $1 < \mu \leq 2$.

(b) $2 < \mu \leq 3$.

(c) $0 < \mu \leq 1$.

(d) $3 < \mu$ .