Section B

4.

The probability of bit errors on a communication line is assumed to be Markovian with the probability of a bit being erroneous equal to 4% if the previous bit was erroneous and 2% if the previous bit was error free.

If the first bit of a packet arrives error free, what is the probability that bit number four is error free?

[8 marks]

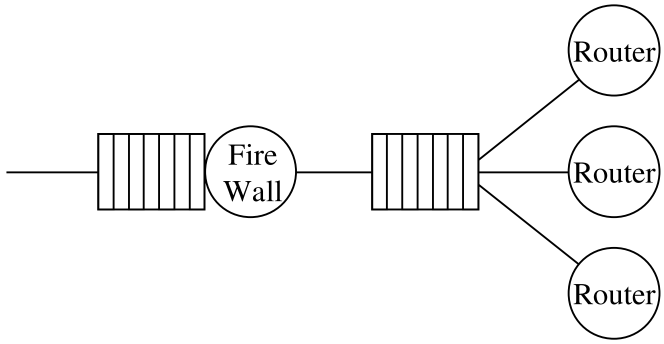
If the first bit of a packet is error free, how many bits on average would we receive before the next erroneous bit?

[8 marks]

What is the steady state bit error rate for the line?

[9 marks]

5.



A firewall is used to protect a company from unauthorised access. Upon arrival, each message is scrutinised before being forwarded to the internal network. The firewall has a maximum of 42 buffers available and the average time needed to scrutinise a message is 25 milliseconds per message. The mean arrival rate is 40 messages per second. Both the inter-arrival time and the time needed to scrutinise are assumed to be exponentially distributed and their means are assumed to be constant throughout the day

What is the probability of finding 36 buffers occupied?

[5 marks]

Eighty percent of the messages pass through the firewall and are placed on a queue. This queue is served by three identical routers. Each router takes 20 milliseconds on average to serve a message.

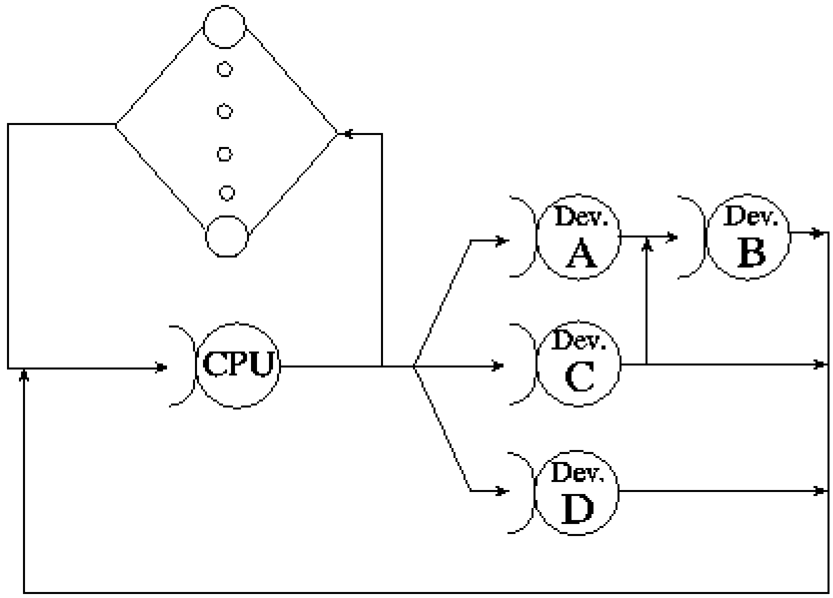
What is the probability of finding all routers busy?

[8 marks]

How long is the average delay between arrival at the firewall queue and removal from the router queue.

[12 marks]

6.



The above timesharing system contains a CPU and four devices (A, B, C and D). The probabilities for jobs completing at the CPU were found to be 0.04 to the users, 0.32 to device A, 0.44 to device C and 0.2 to device D. Jobs at device C have a probability of 0.27 of completing to device B rather than directly to the CPU. The service times were 20 msec for device A, 15 msec for device B, 10 msec for device C and 14 msec for device D. The average service time per visit to the CPU was 5 msec, and the user think time 5 seconds.

For each job, what are the visit ratios for the CPU and each of the four devices (A, B, C and D)?

[6 marks]

What is the total service demand for the CPU and each of the four devices?

[6 marks]

What is the bottleneck device?

[6 marks]

If the utilisation of device A is 8%, what is the average response time if there are 10 users in the system?

[7 marks]