Note: All these problems are *additional* homework exercises (in case you have not yet obtained enough homework points). Each of them is worth 2 points. Deliver your answer sheet (labelled with your student id, name, and signature) into the mail box of the course. Deadline is *Tuesday, 5 December, 3.00 p.m.*

1. There are two telephone lines in a call center. It is found that 3 % of the incoming call requests are lost (due to insufficient capacity of the system). Using the Erlang model, calculate the loss rate under the assumption that the call arrival rate doubles.

2. Consider independent and identical VBR traffic sources in an ATM network. The sources are of the *on-off* type. When active, a source transmits cells with rate $r = 64$ kbit/s (and when idle, the cell rate is 0). A source is active with probability $p = 1/2$ (and idle with probability $1 - p$). Assume that these connections are carried by a VP with fixed capacity $C = 10$ Mbit/s. What is the maximum number of connections that the CAC of this VP can accept, if the QoS requirement is CLR $\leq 10^{-4}$?

3. Consider independent traffic sources using ABR service category in an ATM network. Assume that they generate new connections according to a Poisson process with rate $\lambda = 9$ connections/second. These connections are carried by a VP with fixed capacity $C = 10$ Mbit/s. The purpose of each connection is to transfer a file along this VP. Assume that the file sizes are exponentially distributed with mean $L = 1$ Mbit. In the ideal case, ABR flow control shares the capacity of this VP equally among all the active connections. At connection level, this corresponds to the Processor Sharing (PS) queueing discipline: when there are n connections active, the *momentary* throughput for each connection is C/n. Using the M/M/1-PS queueing model, calculate first the mean holding time of a connection (which equals the average transfer time of a file), and then the average throughput of a connection.