

*Note:* Problem 3 is a homework exercise. Deliver your answer sheet (labelled with your student id, name, and signature) into the mail box of the course, or directly to the course assistant *before* the next exercise class on 4 October.

1. Consider a statistical multiplexer with four incoming links of capacity 155 Mbps. The average packet arrival rates from these four links are as follows: 10, 12, 5 and 3 packets/ms. The average packet length is 400 bytes. Model this as a pure waiting system of type M/M/1 (with one server and an infinite buffer). a) What is the minimum capacity required for the outgoing link in order for the system to be stable? b) Assume then that the capacity of the outgoing link is also 155 Mbps. What is the traffic load? What is the average number of packets in the multiplexer? What is the mean time that the packets stay in the multiplexer?
2. Consider a random access system based on Slotted ALOHA. Let  $T$  denote the length of a time slot in this system. Let  $n$  denote the number of stations using this random access system. Assume that, during interval  $[0, 10T]$ , each station transmits exactly one packet (no retransmissions due to collisions). What is the maximum value for  $n$  if we require that the probability that there will be no collisions during interval  $[0, 10T]$  should be greater than 0.5?
3. *Homework exercise* (deadline 4 October at 9 o'clock): Consider a cell in a mobile telephone network. Ongoing calls within this cell are either *fresh* (originating from the cell) or *handovers* (transferred from another cell). Each ongoing call occupies one of the channels available in the area of the cell. Measurements related to this cell tell that (during the busy hour) the average interarrival time between two consecutive fresh calls is 5 seconds, the average channel occupation time of all calls is 2 minutes, the average number of ongoing calls is 36, and the blocking probability both for the fresh and the handovering calls is essentially 0. By utilizing Little's formula, calculate the arrival rate for the handover calls.