1. Propose an adaptation of the Chandy-Lamport snapshot algorithm (for directed networks with FIFO channels), in which basic messages may be buffered at the receiving processes, and the channel states of the snapshot are always empty. (12 pts)

2. Consider the Bracha-Toueg deadlock detection algorithm.

(a) Let node $u$ initiate a deadlock detection run, in which the wait-for graph above is computed. Give one possible computation on this wait-for graph. (8 pts)

(b) Let node $u$ initiate a deadlock detection run, in which the wait-for graph above is computed, with as only difference that $w$ is waiting for a 2-out-of-3 (instead of a 1-out-of-3) request. Give one possible computation on this wait-for graph. (6 pts)

3. Consider weight-throwing termination detection, where in case of underflow at a process $p$, it gives itself extra weight, and informs the initiator. Give an example
to show that if \( p \) would not wait for an acknowledgement from the initiator, then the initiator could prematurely detect termination. (8 pts)

4. Give an example to show that the Gallager-Humblet-Spira minimal spanning tree algorithm could get into a deadlock if different channels were allowed to have the same weight. Argue that the deadlock in your example is avoided if a total order is imposed on channels with the same weight. (10 pts)

5. Argue that the fact that no Las Vegas algorithm exists for computing the size of an anonymous ring, implies that there is no Las Vegas algorithm for election in anonymous rings. (10 pts)

6. Let \( N = 7 \) and \( k = 2 \), and let the general \( g \) and one lieutenant be Byzantine. Give a computation of the Byzantine broadcast algorithm \( \text{Broadcast}_g(7, 2) \) (and its subcalls) in which all correct lieutenants decide for \( \text{majority} \{0, 0, 0, 1, 1, 1\} \). What is the total number of subcalls? (12 pts)

7. Prove that for each pair of quorums \( Q \) and \( Q' \) in the Agrawal-El Abbadi mutual exclusion algorithm, \( Q \subseteq Q' \) implies \( Q = Q' \). (Hint: Apply induction on the depth of the binary tree.) (12 pts)

8. Give an unfair infinite computation of the Arora-Gouda self-stabilizing spanning tree algorithm that never stabilizes. (Hint: Let only one process perform events.) (12 pts)