## Final Examination (Sample 1) ECE 1771F: Quality of Service, Fall 2018

## Instructor: Baochun Li Department of Electrical and Computer Engineering University of Toronto December 19, 2018, 12 p.m. - 2 p.m.

Notes:

- 1. You have **120 minutes** to complete this examination.
- 2. This is a closed-book closed-notes examination.

Question 1	2	3	4	5	6	7	8	Total
/15	/15	/15	/15	/10	/10	/10	/10	/100

MARKS

## Your Last Name:

Your First Name:

Your Student Number:

1. (15 Points) With Weighted Fair Queueing (WFQ), assuming that we have packets of size 1, 2, and 2 units arriving at a WFQ scheduler at time 0, on equally weighted connections A, B, and C. Afterwards, a packet of size 2 arrives at connection A at time 4. The link service rate is 1 unit/second. (1) What are the finish numbers of all packets? (2) What is the round number when the system becomes idle? and (3) When does this happen? Please justify your answer with an illustration.

2. (15 Points) We claim that in a sealed-bid second-price auction, it is a dominant strategy for each bidder i to choose a bid  $b_i = v_i$ , the true value of bidder i. Please proof this claim.

3. (15 Points) When we claim that *market-clearing* prices are *optimal*, what do we mean by *optimality*? Why are market-clearing prices optimal?

4. (15 Points) Please explain what the basic idea of the *path vector* algorithm is. You may use an example if you feel it is more convenient.

5. (10 Points) In the three-client game, there are two firms and three clients: A, B and C. If the two firms approach the same client, the client will give half its business to each. Firm 1 is too small to attract clients on its own, so if it approaches on client while Firm 2 approaches a different one, then Firm 1 gets a payoff of 0. If Firm 2 approaches client B or C on its own, it will get their full business. However, A is a larger client, and will only do business with both firms. Because A is a large client, doing business with it is worth 8, whereas doing business with B or C is worth 2. What is the Nash equilibrium in this game? Please clearly state your reasons.

6. (10 Points) When we claim that TCP is *self-pacing*, what do we really mean? What is the advantage of being *self-pacing*?

7. (10 Points) How do we ensure *at-least-once delivery* with a transport protocol? Please state the design of a protocol that achieves this goal.

8. (10 Points) What do we mean when we say a choice of strategies — one by each player — is *Pareto-optimal*?