1. **Explain** the following terms and **discuss** their roles in network measurements: (6 p)

   a) QQ-plot
   b) Central limit theorem (CLT)
   c) Self-similarity
   d) Stationary process
   e) Inter-arrival times
   f) Association rule

2. Distributions and fitting: You are given six samples of file transfer durations, $T = \{2/5, 3/5, 2/5, 4/5, 2/5, 1\}$ (measured in minutes).

   a) Let X denote a random variable with cumulative distribution function (cdf) $F(x) = x^k$, with $0 \leq x \leq 1$ and $k \geq 1$. Note that k, the parameter of this distribution, is not necessarily an integer. What is the mean of X (i.e., $E[X]$)? (2 p)

   b) Fit the given distribution (find the value of k) to the samples T using *the method of moments*. (2 p)

   c) Another possible approach is to use *the maximum likelihood method*. What is the likelihood function in this case? (2 p)

Following answers to a separate paper.

3. Explain the difference between active and passive network measurements. Which one is more suitable for: (6 p)

   a) Monitoring how much capacity on network link is used

   b) Observing which services are using most of network capacity.

   c) Verifying network quality is sufficient in call center

   d) Monitoring voice quality in a call center serving customers around the globe

4. Define flow. Why flow is important concept in network measurements? What roles granularity and timeout have with flows? (6 p)

5. You are given a task to develop a simple way for citizens to compare different network providers. A set of probes will be installed into each network distributed over geographical area. Those will send and receive traffic and can calculate simple KPI (key performance indicators) from sent and received traffic. Your goal is to describe a network and its quality score with as few numbers as possible while still enabling fair comparison.

   What measurements results you would include into the final score(s) and you you would calculate it? Take account on different user profiles (like video streaming, gaming, web surfing,...). (6p)