S-104.3610 Nanotechnology (5 cr) **Exam 16.12.2011**

Please answer either in English or Finnish.

1. Explain briefly (max. 2 pages altogether, draw schematics if needed):
   a) extreme ultraviolet optical lithography
   b) dip-pen nanolithography
   c) break-junction technique in molecular electronics
   d) GMR effect
   e) qubit
   f) electrophoresis
   (each 1 p)

2. Principles of scanning probe microscopy, especially scanning tunneling microscopy and scanning capacitance microscopy (6 p)

3. Structure, fabrication, properties and applications of graphene (6 p)

4. a) Compare so-called "top-down" and "bottom-up" methodologies. What are the advantages and difficulties in each approach? (3 p)
   b) Coulomb blockade in single electron transistors (3 p)

5. a) MEMS and NEMS sensors (3 p)
   b) Explain contact angle, interfacial energy and superhydrophobic surface (3 p)