1. **(20 pts)** Explain the following processor design concepts. For each one, give a code sequence for example to illustrate how the design concept can be applied.
   (a) Instruction-level parallelism
   (b) Loop-level parallelism
   (c) Thread-level parallelism
   (d) Data parallelism.

2. **(20 pts)** Explain the difference between the RISC (Reduced Instruction Set Computer) and the CISE (Complex Instruction Set Computer) structures.

3. **(20 pts)** In an out-of-order execution processor, speculative execution of instructions is a very important design.
   (a) Explain what the speculative execution is
   (b) Explain how the ROB (Reorder Buffer) can support speculative execution

4. **(20 pts)** Explain how compiler optimization helps to improve the performance of a multi-core processor. Give a program transform example to show the concepts.

5. **(20 pts)** There are some challenges when applying the parallel processing techniques to computer architecture (e.g., parallel processors) design. List any two of challenges and explain why they are indeed the challenges.