**CPRE 381- Intro to Computer Organization & Implementation**

**HW1**

**Due Date: Sept 8, 2017**

1. Consider a processor running at 1GHz with the following CPI values:

ALU: 1.15; Memory: 1.25; Control: 1.35

Given a program with a loop with a loop body of 200 instructions iterated 1000 times, and the following instruction mix for the program (ALU- 33%; Memory- 35%; Control- 32%), what is the execution time of this program on this processor? **[10 points]**

1. A programmer found a way to eliminate 20 instructions per loop iteration from the program in Problem 1. Given that 20 eliminated instructions contain 6 ALU instructions, 8 Memory instructions; and 6 Control instructions, what is the CPI of the optimized program? What is the execution time of the optimized program? **[10 points]**
2. The processor designer was able to make ALU 20% faster implying that the new CPI for ALU is 0.8\*old CPI for ALU. What is the execution time of the program in Problem 1 on this improved processor? **[10 points]**
3. The compiler found a magical way of transforming 20% of the control instructions into an equal number of memory instructions and ALU instructions equal to 25% of extra memory instructions. For every *N* control instructions eliminated (which is 20% of all control instructions), *N* memory instructions and 0.*25\*N* ALU instructions are introduced. What is the new execution time of the program in Problem 1 with this new transformation? **[10 points]**
4. Now let us consider an improved transformation. Compiler can convert a control instruction into corresponding 1.1 memory instructions (Some *N* control instructions get converted into *1.1\*N* memory instructions). What fraction of the execution time of Program on Machine in Problem 1 can be enhanced with this transformation? What is the speed-up of this transformation? What is the asymptotic speed-up due to this transformation according to Amdahl’s law? **[10 points]**