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Student : Name:_____ Roll No._____ Section:_____

Question 1a [6]

What is the difference between super-pipeling and superscalar? How in ideal case we can achieve 4 times improvement in both designs?

Question 1b [4]

What is branch prediction? What is the difference between 1bit and 2 bit branch prediction?

Question 2 [10]

Consider the following MIPS assembly language code. Assume that we run this code on the five stages pipelined data path. Division consumes 2 cycles in execution.

1. **Loop: ld R6, 0(R2)**
2. **ld R1, 100(R2)**
3. **div R3, R3, R1**
4. **sw R3, 0(R2)**
5. **sub R6, R6, 10**
6. **add R2, R2, 4**
7. **bne R2, 40, Loop**

a) Add stalls in the above code to remove all data and control hazards. Assume full forwarding (Exe to Exe, Mem to Exe, Exe to Dec, Mem to Mem) is implemented.

b) Rearrange the code to remove as many stalls as possible.