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

Question 1 [12]

Consider the following MIPS assembly language loop. Assume that we run this code on the five stages pipelined data path.

1. **Loop: ld R2, 100 (R4)**
2. **addi R2, R2, 4**
3. **ld R3, 200 (R4)**
4. **addi R3, R3, 4**
5. **add R5, R2, R3**
6. **sw R5, 300 (R4)**
7. **addi R4, R4, 4**
8. **beq R4, R7, Loop**

   a) Find all possible hazards in the above code. Fill the following table by writing lines and register in front of particular hazard. Equality for branch is done in decode stage instead of execution stage.

With Forwarding			Add stalls in the above code to remove all hazards	Reschedule the code to remove as many stalls as possible
Hazard	Lines	Register		
WAR				
WAW				
RAW				

Question 2 [8]

Examine the accuracy of branch predictors for the following repeating patterns (e.g., in a loop) of branch outcomes. Accuracy is defined as the percentage of guesses that are correct.

 (a) T, NT, T, NT, NT

1. What is the accuracy of always taken and always not taken static branch predictors?

2. What is the accuracy of a dynamic branch predictor? Assume this predictor starts in the "Predict not taken" state.