**Homework Chapter 5 Part 1**  
**Computer Organization Spring 2003**

Due date: Wednesday, 2/26/03

**Problem 1 (40 points)**

Consider the single-cycle implementation given in Figure 5.29. You are to add an *addi* instruction, i.e., an add with immediate data. Indicate any changes to the datapath that must be done, e.g., extra wires, extra logic, extra registers, etc. Also specify the values of all of the control lines that control the datapath and guarantee correct execution. Be sure to justify your answer.

**Problem 2 (20 points)**

Textbook problem 5.14. Use the single cycle implementation in Figure 5.29 for this problem. Be sure to provide details of the derivation of your answer, i.e., be specific about why you have chosen a particular critical path through the machine.

**Problem 3 (40 points)**

Consider the datapath and control lines for the single-cycle implementation including the jump instruction in the Figure 5.29.

Explain the additions to the datapath and control needed to implement the *jal* instruction. (You may include a copy of Figure 5.29 with your modifications drawn onto it in your solutions.) You may add new control lines and/or you may add bits to the current control fields as needed. In any case, give the appropriate settings of the control lines in the table below and indicate the settings of any additional lines if you need them.

Recall, the *jal* instruction is the jump and link used to implement a function call. It has the same format as the jump (*j*) instruction. It transfers control to the specified target address, like a jump, but also places $PC + 4$ in $31$.

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<tr>
<th></th>
<th>Reg Dst</th>
<th>ALU Src</th>
<th>Memto Reg</th>
<th>Reg Write</th>
<th>Mem Read</th>
<th>Mem Write</th>
<th>Branch</th>
<th>Jump</th>
<th>ALU Op1</th>
<th>ALU Op2</th>
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<tbody>
<tr>
<td><em>jal</em></td>
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