1) Consider the following piece of EMY mnemonic machine language program:

400000  LW  R8, 0(R9)  # Load from location 10000000
400004  ANDI R10, R8, 1
400008  SLL  R10, R10, (31)_{10}
40000C  SRL  R8, R8, 1
400010  OR  R8, R8, R10
400014  SW  R8, 0(R9)

---- ----
10000000 8ECA6421

a) Obtain a table that shows the values of registers and memory locations used by the above piece of EMY code as shown in class. Also show the number of memory accesses made for each instruction.

Show the work to get AND, SLL, SRL and OR results. That is, show how you got the result bits for the AND, SLL, SRL and OR instructions.

b) Invent a new EMY instruction that exactly implements the instructions in locations 400004, 400008, 40000C and 400010 above (the ANDI, SLL, SRL and OR).

Indicate only the following: Its syntax, semantics, format and the memory accesses made. Again, make sure the instruction exactly implements what the four instructions do!

Then, rewrite the above code starting at 400000 so that the new EMY instruction is used. Add comments to your code.

(35 pts)

2) Consider the following pseudoinstruction in the mnemonic machine language notation:

DOLOOP Rs, Length  # Rs Rs - 1 then If Rs = 0 then PC PC + (4* (Length\(^+\)))
Also, consider the following piece of EMY mnemonic machine language program:

<table>
<thead>
<tr>
<th>Address</th>
<th>Opcode</th>
<th>Arguments</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>400000</td>
<td>ADDI</td>
<td>R8, R8, (-1)$_{10}$ # R8 has 1 initially</td>
<td></td>
</tr>
<tr>
<td>400004</td>
<td>BEQ</td>
<td>R8, R0, 4</td>
<td></td>
</tr>
<tr>
<td>400008</td>
<td>LW</td>
<td>R9, 0(R10) # Load from location 10000000</td>
<td></td>
</tr>
<tr>
<td>40000C</td>
<td>ADD</td>
<td>R11, R11, R9 # R11 has 0 initially</td>
<td></td>
</tr>
<tr>
<td>400010</td>
<td>ADDI</td>
<td>R10, R10, 4</td>
<td></td>
</tr>
<tr>
<td>400014</td>
<td>J</td>
<td>100000</td>
<td></td>
</tr>
</tbody>
</table>

---

10000000 5

a) Obtain a table that shows the values of registers and memory locations used by the above piece of EMY code as shown in class.

Also show the number of memory accesses made for each instruction.

b) A number of instructions in the code above implement the pseudoinstruction. Indicate which instructions implement the DLOOP instruction and then rewrite the above code by using the pseudoinstruction. Add comments to your code.

Assume that this instruction is added to the EMY instruction set. Indicate only its format, arguments and memory accesses made. Do not mention the addressing modes. Explain your decisions!

(15 pts)

3) Consider the following bit sequence:

0010 0011 1001 0000 1000 0000 0000 0000

Assume that this bit sequence represents an EMY instruction. Determine what this instruction is and write in the mnemonic format.

Assume that this instruction is in location 400000. Add a comment to the instruction.

Assume that if the instruction is using Rs, Rt and Rd registers, their values are 8000, A000000F and 2E, respectively.

Then, determine the result of the operation indicated by the instruction! Show the work to get the bits of the result.