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| --- | --- | --- | --- | --- |
| **Question** | **Q4** |  | **Name** |  |
| **Your score** |  |  | **Student ID** |  |
| **Full score** | **15** |  |  |  |

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| EE3046 Microcomputers Theory and Laboratory, 2022 Spring Semester  **Final Exam (8051)** *Scope*: CPU design*Time*: 18:00~20:50 |

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| |  |  | | --- | --- | | Best viewing mode for this question sheet in Microsoft Word program |  |      |  |  | | --- | --- | | Input files | 9876543210陳小美Q1 solution.circ  2021Fall-FinalExam - Section 2 - Q.docx | | Answer upload | Enter your answers to Q2  <https://docs.google.com/forms/d/e/1FAIpQLSdt3MBfy4x3PqyRpcWnY-DHFi4VnxOtNb80KIyymXSoECQOYg/viewform?usp=sf_link> | |

Section 2：

Q4. (15%) Circuit modification to adopt the INC/DEC instructions

**Instructions to be adopted：**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  | | --- | --- | | **INC @Ri** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 0000011i | | | **Operation** | INC  (Ri) = (Ri) + 1 | | **Example** | INC @R0 |  |  |  | | --- | --- | | **INC A** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 00000100 | | | **Operation** | INC  A = A + 1 | | **Example** | A = A + 1 |  |  |  | | --- | --- | | **INC direct** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 2 | | **Cycles** | 1 | | **Encoding** | |  |  |  | | --- | --- | --- | | 00000101 |  | direct | | | **Operation** | INC  (direct) = (direct) + 1 | | **Example** | INC 34h |  |  |  | | --- | --- | | **INC Rn** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 00001nnn | | | **Operation** | INC  Rn = Rn + 1 | | **Example** | INC Rn | | |  |  | | --- | --- | | **DEC @Ri** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 0001011i | | | **Operation** | DEC  (Ri) = (Ri) - 1 | | **Example** | DEC @R1 |  |  |  | | --- | --- | | **DEC A** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 00010100 | | | **Operation** | DEC  A = A - 1 | | **Example** | DEC A |  |  |  | | --- | --- | | **DEC direct** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 2 | | **Cycles** | 1 | | **Encoding** | |  |  |  | | --- | --- | --- | | 00010101 |  | direct | | | **Operation** | DEC  (direct) = (direct) - 1 | | **Example** | DEC 35h |  |  |  | | --- | --- | | **DEC Rn** | | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** |  | **P** | | | | **Bytes** | 1 | | **Cycles** | 1 | | **Encoding** | |  | | --- | | 00011nnn | | | **Operation** | DEC  Rn = Rn - 1 | | **Example** | DEC R7 | |

Circuit modification：

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| Please modify the library circuit **9876543210 陳小美 Q4 - Lib.circ** in the directory **myLib** so that the CPU circuit **9876543210 陳小美 Q4.circ** will be able to execute the INC and DEC instructions listed above.  Note: **9876543210 陳小美 Q4.circ** contains the same CPU circuit as **9876543210 陳小美 Q1.circ** does.  ***Note***: Only modify the library circuit. Don’t modify the CPU circuit.  提醒：After finishing, please upload the ***library*** circuit file **9876543210 陳小美 Q4 - Lib.circ**. |