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| **Question** | T1 |  | P1 | P2 | P3 |  |  | Q1 | Q2 | Q3 | Q4 | Q5 |  |  | **Total** | **Name** |  |
| **Your score** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **St. ID** |  |
| **Full score** | 4 |  | 10 | 15 | 15 |  |  | 10 | 12 | 10 | 10 | 14 |  |  | **100** | **Seat** |  |

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| EE3046 Microcomputers Theory and Laboratory, **Spring** Semester 2022  **Midterm Exam (8051)** *Scope*: edsim51*Time*: 18:00~20:30, 2022.05.02 |

查看期中考繳交記錄：<https://docs.google.com/spreadsheets/d/10iAwLlMrli9tBttWnMPN4ZYp0ZIUz8eiRm6inOR1NJg/edit?usp=sharing>

Your name will be shown right after you upload your answer to P1, P2, P3, or Q part (i.e., this WORD file).

T1: (4%)

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| The performance in uploading your answering files.  For example, if your filename doesn’t conform to the requested format, the score (max. 4%) will be reduced. |

P1: (10%) ASCII code test

|  |
| --- |
| This template program contains a subroutine called “lowercaseTest”. The subroutine tests whether the accumulator contains the ASCII code of a lowercase letter (i.e., ‘a’, ‘b’, …, or ‘z’). Before return (i.e., RET), the subroutine sets the carry flag if it is a lowercase letter; otherwise, it clears the carry flag.  Download the template program at <http://www.ee.ncu.edu.tw/~jztsai/EE3046/mmmQQQQ/> |
| Note:  When you upload your program for P1, the file name must be " stdID yourName P1.asm ", for example, “987654321 陳小美 P1.asm “. |
| The link for uploading your program for P1：  <https://docs.google.com/forms/d/e/1FAIpQLSfnb62gyeHGdAEN5qFeLYDqG8g5yX4f_8QFt5wmDg3DmTkkTQ/viewform?usp=sf_link> |
| Note: Don’t forget to press the submit (提交) buttom after you have selected your files for uploading. |

P2: (20%) Sample and display

|  |
| --- |
| In Example 6 of edsim51, the analog input voltage is sampled and displayed on the Scope every 50 μs.  Now, the P2 program will display the voltage difference between the newly sampled input analog voltage and the input analog voltage sampled 250 μs ago. That is to say, the P2 program will display Vin(t) – Vin(t – 250 μs), where t is a sampled time instance. |
| Note:  When you upload your program for P2, the file name must be " stdID yourName P2.asm ", for example, “987654321 陳小美 P2.asm “. |
| The link for uploading your program for P2：  <https://docs.google.com/forms/d/e/1FAIpQLSdqFuizzlEg_2c2C4f4bqF6QuXNkGWajZBcql9sitzt1Uh4EA/viewform?usp=sf_link> |

P3: (15%) Motor rotation

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| In this program, the motor rotates for a specified number of revolutions.  The function of this program is described in the following items:   |  |  | | --- | --- | | 1 | Before the program starts, the register R7 stores a number that specifies the number of revolutions for motor rotation. | | 2 | After the program starts, the motor starts to rotate for the specified number of revolutions. | | 3 | During the time of motor rotation, the LED keeps showing the “decreasing pattern” continuously.  The “decreasing pattern” is implemented as follows:   |  | | --- | | decreasingLED:  DEC R1  MOV P1,R1  JMP decreasingLED | | | 4 | The motor sensor must be connected to P3.3, as show in the figure below.  That is to say, the external interrupt 1 must be used for counting the number of revolutions. | |
| Note:  When you upload your program for P3, the file name must be " stdID yourName P3.asm ", for example, “987654321 陳小美 P3.asm “. |
| The link for uploading your program for P3：  <https://docs.google.com/forms/d/e/1FAIpQLScDlx_TvjPH2zaU962AFOCEGIqBS78l2lYQ-8ZkJ7zGPL9IqA/viewform?usp=sf_link> |

Q1: (10%)

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| --- | --- | --- | --- | --- | --- |
| The following program is executed. The content of the data memory is observed while running a NOP instruction in the subroutine called **sub2,** and its snapshot is shown in the figure below. Indeed, the stack content is observed.   |  | | --- | | LJMP main  ORG ????H ; 🡸 The number is masked intentionally.  main:  MOV SP,#10H  MOV R3,#0AFH  MOV A,36H  MOV 7FH,#0C8H  **PUSH 7FH**  **LCALL sub1 ; Find the address of this instruction**  CPL C  NOP  NOP  **POP 7FH**  JMP $  ORG ????H ; 🡸 The number is masked intentionally.  **sub1:**  SUBB A,#33H  **LCALL sub2 ; Find the address of this instruction**  DA A  RET  ORG ????H ; 🡸 The number is masked intentionally.  **sub2:**  **PUSH AR3**  DEC R3  NOP  NOP  **; Observe the data memory at this instance.**  NOP  MOV 78H,R3  **POP AR3**  RET |     Please find out the addresses of the two LCALL instructions.   |  |  | | --- | --- | | 1. The address of LCALL sub1 = | H | | 1. The address of LCALL sub2 = | H | |

Q2: (12%) Branch destination

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The following table shows an instruction sequence, the machine code of the branch instructions, and the code memory address where the machine code is stored.  In the “Destination” column, please write down the destination for each branch instruction.  For example, the branch instruction at LB66 is **LJMP LB11.** The destination for the long jump instruction is **LB11**.   |  |  |  |  | | --- | --- | --- | --- | | Address | Machine code | Assembly Instruction | Destination | |  |  | **org 1234H** |  | | 1234 |  | **LB11: INC A** |  | | 1235 |  | **LB12: MOV R3,AR5** |  | | 1237 |  | **LB13: DEC @R1** |  | | 1238 |  | **LB14: RL A** |  | | 1239 |  | **LB15: ADD A,R3** |  | |  |  |  |  | |  |  | **org 2811H** |  | | 2811 |  | **LB21: INC R2** |  | | 2812 | 02 3A 8C | **LB22: LJMP LB??** |  | | 2815 |  | **LB23: MUL AB** |  | | 2816 |  | **LB24: DEC A** |  | | 2817 |  | **LB25: POP 20H** |  | |  |  |  |  | |  |  | **org 3628H** |  | | 3628 |  | **LB31: PUSH 70H** |  | | 362A |  | **LB32: ANL C,65H** |  | | 362C |  | **LB33: SWAP A** |  | | 362D | E1 4A | **LB34: AJMP LB??** |  | | 362F |  | **LB35: RR A** |  | |  |  |  |  | |  |  | **org 36CCH** |  | | 36CC | 80 05 | **LB41: SJMP LB??** |  | | 36CE |  | **LB42: INC R4** |  | | 36CF | 40 75 | **LB43: JC LB??** |  | | 36D1 |  | **LB44: ORL A,#98H** |  | | 36D3 |  | **LB45: SETB C** |  | |  |  |  |  | |  |  | **org 3744H** |  | | 3744 |  | **LB51: ANL A,#75H** |  | | 3746 |  | **LB52: DA A** |  | | 3747 | B4 25 87 | **LB53: CJNE A,#25H,LB??** |  | | 374A |  | **LB54: XCH A,R6** |  | | 374B | C1 2A | **LB55: AJMP LB??** |  | |  |  |  |  | |  |  | **org 3A88H** |  | | 3A88 |  | **LB61: CPL 56H** |  | | 3A8A |  | **LB62: CLR 76H** |  | | 3A8C |  | **LB63: SUBB A,R7** |  | | 3A8D |  | **LB64: RRC A** |  | | 3A8F | 02 12 34 | **LB66: LJMP LB11** | **LB11** | |

Q3: (10%) Number system

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. Convert a signed binary number to a sign-magnitude binary number, and vice versa.  |  |  |  | | --- | --- | --- | | Sign-magnitude |  | Signed binary | | 1010 | 🡪 |  | |  | 🡨 | 11111101101 |  1. You are given two signed binary numbers: 100110 and 01101.   Do the subtraction.  Express the result in 8-bit signed binary number.  Express the result in signed binary number with the minimal bit number.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  | 1 | 0 | 0 | 1 | 1 | 0 |  | | — |  |  |  | 0 | 1 | 1 | 0 | 1 |  | | = |  |  |  |  |  |  |  |  | (Format: 8-bit signed binary number, 8-bit) | | = |  |  |  |  |  |  |  |  | (Format: signed binary number, minimal bit number) | |

Q4. (10%) Addressing mode

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| The following are addressing modes for 8051 instructions：  ①Immediate ②Register ③Direct ④Indirect ⑤Indexed ⑥Relative ⑦Absolute ⑧Long  Please determine the addressing modes for the underlined operands of the following instructions:     |  |  | | --- | --- | | Addressing mode | Instruction | | ② | ADD A, R4 | |  | CJNE A, 65H, LB12 | |  | MOV @R1, A | |  | PUSH Acc | |  | DJNZ 44H, -12 | |  | MOV A, @A+PC | |

Q5: (14%) Disassembling

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| --- | --- |
| An assembly program was assembled. This program may contain the following instructions:  **ADD or SUBB, DEC or INC, ANL or XRL, CJNE or DJNZ, LJMP or SJMP, and MOV.**  The following shows the content of the code ROM after the program is assembled.      Please write down the complete instructions of this program.   |  | | --- | | MAIN:  ORG 5577H | |

**Upload the WORD file containing your answers for Q1~Q5 to**

[**https://docs.google.com/forms/d/e/1FAIpQLSeoh1Hs49bEnvAQ53ZyZMYn9bedYmeKpYSYG7ZpRIDBFekvRA/viewform?usp=sf\_link**](https://docs.google.com/forms/d/e/1FAIpQLSeoh1Hs49bEnvAQ53ZyZMYn9bedYmeKpYSYG7ZpRIDBFekvRA/viewform?usp=sf_link)