МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РФ

федеральное государственное бюджетное образовательное учреждение высшего образования

**«Вологодский государственный университет»**

**Институт математики, естественных и компьютерных наук**

**Информатика и вычислительная техника**

**ОТЧЁТ ПО ЛАБОРАТОРНОЙ РАБОТЕ №5**

**«Командный цикл процессора»**

Дисциплина: «ЭВМ и периферийные устройства»

Направление подготовки: 09.03.01. Информатика и вычислительная техника

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Вологда

2022 г.

**Задание 1**

Выполнить снова последовательность команд по варианту задания из *разд. 10.3.3* (см. табл. 10.4), но в режиме **Шаг**. Зарегистрировать изменения состояния процессора и памяти в форме табл. 10.12, в которой приведены состояния ЭВМ при выполнении примера из *разд. 10.3.2* (фрагмент).

Код программы:

IN

RD 4

SUB #8

WR 8

WR @8

JNZ 001

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PC | Мнемокод | Микрокоманда | ОЗУ | | CR | | | АУ | | Ячейки |
|  |  |  | MAR | MDR | COP | TA | ADR | Acc | DR | 008 |
| 000 | IN | MAR := PC | 000 | 000000 | 00 | 0 | 000 | 0000000 | 0000000 |  |
|  |  | MRd | 000 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 010000 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 0 |  |  |  |  |  |
| 001 |  | Acc := IR |  |  |  |  |  |  |  |  |
|  | RD 4 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 001 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 210004 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 21 |  | 004 |  |  |  |
| 002 |  | MAR := ADR |  |  |  |  |  |  |  |  |
|  |  | MRd | 004 |  |  |  |  |  |  |  |
|  |  | Acc := MDR |  | 222008 |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 222008 |  |  |
|  | SUB #8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd |  |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 241008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 24 | 1 | 08 |  |  |  |
| 003 |  | DR := ADR |  |  |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  |  |  |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 222016 |  |  |
|  | WR 8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd |  | 220008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 22 | 0 | 008 |  |  |  |
| 004 |  | MAR := ADR |  |  |  |  |  |  |  |  |
|  |  | MDR := Acc | 008 |  |  |  |  |  | 000008 |  |
|  |  | MWr |  | 222016 |  |  |  |  |  | 222016 |
|  | WR @8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 004 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 222008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  |  |  |  |  |  |  |
| 005 |  | MAR := ADR |  |  |  | 2 |  |  |  |  |
|  |  | MRd | 008 |  |  |  |  |  |  |  |
|  |  | RA := MDR |  | 222016 |  |  |  |  |  |  |
|  |  | MAR := RA |  |  |  |  |  |  |  |  |
|  |  | MDR := Acc | 016 |  |  |  |  |  |  |  |
|  |  | MWr |  |  |  |  |  |  |  |  |
|  | JNZ 1 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 005 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 120001 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 12 | 0 | 001 |  |  |  |
| 006 |  | JNZ |  |  |  |  |  |  |  |  |
| 001 |  | END\_COMMAND |  |  |  |  |  |  |  |  |

**Задание 2**

Записать последовательность микрокоманд.

Код программы:

ADD R3

ADD @R3

ADD @R3+

ADD -@R3

JRNZ R3,M

MOV R4,R2

JMP M

CALL M

RET: PUSH R3

POP R5

M: IN

RD 4

SUB #8

WR 8

WR @8

JNZ 001

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PC | Мнемокод | Микрокоманда | ОЗУ | | CR | | | АУ | | Ячейки |
|  |  |  | MAR | MDR | COP | TA | ADR | Acc | DR | R3 |
| 000 | ADD R3 | MAR := PC | 000 | 000000 | 00 | 0 | 000 | 000000 | 000000 |  |
|  |  | MRd | 000 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 330003 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 33 |  | 003 |  |  |  |
| 001 |  | RAR := CR5 |  |  |  |  |  |  |  |  |
|  |  | RRd |  |  |  |  |  |  |  |  |
|  |  | DR := RDR |  |  |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  |  |  |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  | ADD @R3 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 001 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 334003 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  |  | 4 |  |  |  |  |
| 002 |  | RAR := CR5 |  |  |  |  |  |  |  |  |
|  |  | RRd |  |  |  |  |  |  |  |  |
|  |  | RA := RDR |  |  |  |  |  |  |  |  |
|  |  | MAR := RA |  |  |  |  |  |  |  |  |
|  |  | MRd | 000 |  |  |  |  |  |  |  |
|  |  | DR := MDR |  | 330003 |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  | 330003 |  |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 330003 |  |  |
|  | ADD @R3+ | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 002 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 335003 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  |  | 5 |  |  |  |  |
| 003 |  | RAR := CR5 |  |  |  |  |  |  |  |  |
|  |  | RRd |  |  |  |  |  |  |  |  |
|  |  | RA := RDR |  |  |  |  |  |  |  |  |
|  |  | MAR := RA |  |  |  |  |  |  |  |  |
|  |  | MRd | 000 |  |  |  |  |  |  |  |
|  |  | DR := MDR |  |  |  |  |  |  |  |  |
|  |  | INC\_GR |  |  |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  |  | 000001 |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 560006 |  |  |
|  | ADD -@R3 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 003 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  |  |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  |  | 6 |  |  |  |  |
| 004 |  | RAR := CR5 |  |  |  |  |  |  |  |  |
|  |  | DEC\_GR |  |  |  |  |  |  |  |  |
|  |  | RRd |  |  |  |  |  |  |  | 000000 |
|  |  | RA := RDR |  |  |  |  |  |  |  |  |
|  |  | MAR := RA |  |  |  |  |  |  |  |  |
|  |  | MRd | 000 |  |  |  |  |  |  |  |
|  |  | DR := MDR |  | 330003 |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  |  |  |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 790009 |  |  |
|  | JRNZ R3,M | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd |  |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 173010 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 17 | 3 | 10 |  |  |  |
| 005 |  | RAR := CR2 |  |  |  |  |  |  |  |  |
|  |  | DEC\_GR |  |  |  |  |  |  |  |  |
|  |  | JRNZ |  |  |  |  |  |  |  | 100001 |
| 010 |  | END\_COMMAND |  |  |  |  |  |  |  |  |
|  | IN | MAR := PC | 000 |  |  |  |  |  |  |  |
|  |  | MRd | 010 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 790009 |  |  |  |  | 330003 |  |
|  |  | PC := PC+1 |  |  | 01 | 0 | 00 |  |  |  |
| 011 |  | Acc := IR |  | 010000 |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 000000 |  |  |
|  | RD 4 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 011 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 210004 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 21 | 0 | 004 |  |  |  |
| 012 |  | MAR := ADR |  |  |  |  |  |  |  |  |
|  |  | MRd | 004 |  |  |  |  |  |  |  |
|  |  | Acc := MDR |  | 173010 |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 173010 |  |  |
|  | SUB #8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 012 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 241008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 24 | 1 | 008 |  |  |  |
| 013 |  | DR := ADR |  |  |  |  |  |  |  |  |
|  |  | ALU <-- COP |  |  |  |  |  |  | 000008 |  |
|  |  | Start ALU |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  | 173018 |  |  |
|  | WR 8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd |  | 220008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 22 | 0 | 008 |  |  |  |
| 014 |  | MAR := ADR |  |  |  |  |  |  |  |  |
|  |  | MDR := Acc | 008 |  |  |  |  |  | 000008 |  |
|  |  | MWr |  | 173018 |  |  |  |  |  | 222016 |
|  | WR @8 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 014 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 222008 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  |  |  |  |  |  |  |
| 015 |  | MAR := ADR |  |  |  | 2 |  |  |  |  |
|  |  | MRd | 008 |  |  |  |  |  |  |  |
|  |  | RA := MDR |  | 173018 |  |  |  |  |  |  |
|  |  | MAR := RA |  |  |  |  |  |  |  |  |
|  |  | MDR := Acc | 018 |  |  |  |  |  |  |  |
|  |  | MWr |  |  |  |  |  |  |  |  |
|  | JNZ 1 | MAR := PC |  |  |  |  |  |  |  |  |
|  |  | MRd | 015 |  |  |  |  |  |  |  |
|  |  | CR := MDR |  | 120001 |  |  |  |  |  |  |
|  |  | PC := PC+1 |  |  | 12 | 0 | 001 |  |  |  |
| 016 |  | JNZ |  |  |  |  |  |  |  |  |
|  |  | END\_COMMAND |  |  |  |  |  |  |  |  |