UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2006/2007

April 2007

ZAT 281/4 - Introduction to Microprocessors
[Pengantar Mikropemproses]

Duration: 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **SEVEN** printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instruction: Answer all **FIVE** questions. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab kesemua **LIMA** soalan. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

1. Figure 1 is a 68000 program shown as a series of S-records.

   [*Rajah 1 merupakan aturcara 68000 yang menunjukkan suatu siri rekod-S.*]

   a) What is the starting address of the program?
   [*Apakah alamat permulaan aturcara tersebut?*]

   (20/100)

   b) What is the length/size of the program?
   [*Berapakah panjang/saiz aturcara tersebut?*]

   (20/100)

   c) What is the last address of the program?
   [*Apakah alamat terakhir aturcara?*]

   (20/100)

   d) Figure 2 shows a single line of a hexadecimal file containing S-record. The checksum appears in the last two characters as "00". It is incorrect. What is the correct checksum?
   [*Rajah 2 menunjukkan suatu baris fail perenambelasan yang mengandungi rekod-S. Periksa jumlah yang dipaparkan oleh dua aksara terakhir iaitu "00" adalah salah. Apakah periksa jumlah yang betul?*

   (40/100)

```
S0060000657834E8
S208400500000164OD40
S21440040013FC00FF00A00007103800013C000A037
S2144004100013610C52000A00000066F04E4B0000CC
S2104004202239004005005381166FC4E75F2
S9030000FC
```

Figure 1 [*Rajah 1*]

```
S214400410103900A0001913C000A000131A00020500
```

Figure 2 [*Rajah 2*]

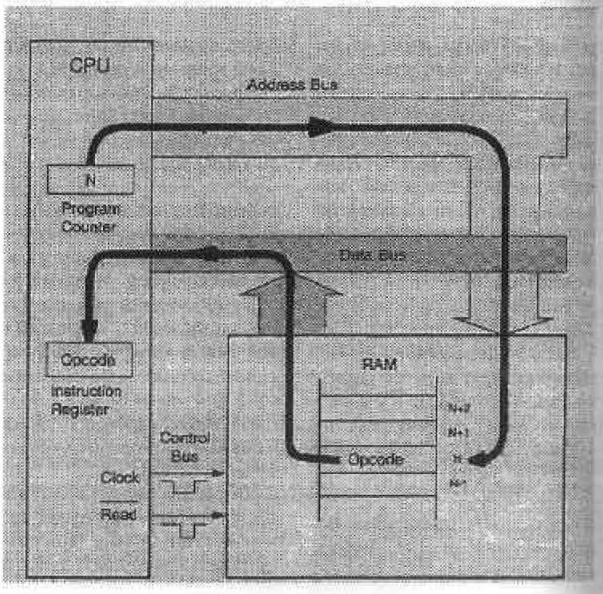


Figure 3 [*Rajah 3*]

2. Figure 3 shows a block diagram of 68000 microprocessor system showing an opcode fetch operation.
[Rajah 3 menunjukkan gambarajah blok sistem mikropemproses 68000 yang menerangkan operasi pengambilan opkod]

a) If the starting address of the RAM with 1Mbyte capacity is $00400400, draw the RAM location in the 68000's address space map.
[Jika alamat permulaan RAM bersaiz 1 Mbyte ialah $00400400, lakarkan lokasi RAM dalam peta ruang alamat 68000]

(25/100)

b) In what block is the RAM located if the 68000's address space is divided into 8 blocks of the same size?
[Dalam blok apakah RAM tersebut terletak sekiranya ruang alamat 68000 dibahagi kepada 8 blok yang sama saiznya]

(25/100)

c) List the steps-by-step of read cycle timing operation of the opcode fetch in Figure 3.
[Senaraikan langkah demi langkah operasi masa kitaran baca untuk pengambilan data dalam Rajah 3.]

(25/100)

d) If a word size of instruction is being fetched from the starting address of the RAM, what is the content of the program counter (PC) after the word has been fetched?
[Jika arahan bersaiz perkataan diambil daripada alamat permulaan RAM, Apakah kandungan pembilang program (PC) selepas perkataan tersebut diambil?]

(25/100)

```
 1                          *       EXPERIMENT 9
 2                          *       DRIVING 4 SEVEN SEGMENT DISPLAY
 3                          *       EXP9.SRC
 4  00A00009                PCDDR   EQU     $A00009
 5  00A00007                PBDDR   EQU     $A00007
 6  00A00013                PBDR    EQU     $A00013
 7  00A00019                PCDR    EQU     $A00019
 8  00400400                PROGRAM EQU     $400400         PROGRAM ADDRESS
 9  00400500                DATA    EQU     $400500         DATA AREA
10  000009FF                DELTIME EQU     $9FF            SET MUTIPLEX DELAY
11  004004A0                TOTAL   EQU     $4004A0
12  004004FE                SPLOC   EQU     $4004FE
13  00400400                        ORG     PROGRAM
14  00400400                START
15  00400400 13FC00FF               MOVE.B  #$FF,PCDDR      SET PORT C AS OUTPUT
    00400404 00A00009
16  00400408 13FC00FF               MOVE.B  #$FF,PBDDR      SET PORT B AS OUTPUT
    0040040C 00A00007
17  00400410 227C0040               MOVE.L  #DIGIT,A1       SET A1 TO POINT TO DIGIT
    00400414 0514
18  00400416 2E7C0040               MOVE.L  #SPLOC,A7
    0040041A 04FE
19  0040041C 1C3C0004               MOVE.B  #4,D6
20  00400420 207C0040               MOVE.L  #PATNS,A0       A0 POINTER TO PATTERNS
    00400424 0504
21  00400426 247C0040               MOVE.L  #NOMBOR,A2
    0040042A 0500
22  0040042C 3A1A                   MOVE.W  (A2)+,D5
23  0040042E DA52                   ADD.W   (A2),D5
24  00400430 33C50040               MOVE.W  D5,>SUM
    00400434 04A0
25  00400436 12C5           ADD1    MOVE.B  D5,(A1)+
26  00400438 E84D                   LSR     #4,D5
27  0040043A 66FA                   BNE     ADD1
28  0040043C 227C0040               MOVE.L  #DIGIT,A1
    00400440 0514
29  00400442 0219000F       ADD2    ANDI.B  #$0F,(A1)+
30  00400446 5306                   SUBQ.B  #1,D6
31  00400448 66F8                   BNE     ADD2
32  0040044A 143C0004       REPEAT  MOVE.B  #4,D2           SET D2 AS COUNTER
33  0040044E 227C0040               MOVE.L  #DIGIT,A1       SET A1 TO POINT TO DIGIT
    00400452 0514
34  00400454 163C0001               MOVE.B  #1,D3           SELECT DIGIT
35  00400458 1019           NEXT    MOVE.B  (A1)+,D0        GET DIGIT TO DISPLAY & POINT TO NEXT
36  0040045A 12300000               MOVE.B  0(A0,D0),D1     GET EQUIV. PATTERN
37  0040045E 13C100A0               MOVE.B  D1,PBDR         OUPUT PATTERN
    00400462 0013
38  00400464 13C300A0               MOVE.B  D3,PCDR         AND SWITCH ON
    00400468 0019
39  0040046A 61000012               BSR     DELAY           WAIT
40  0040046E 13FC0000               MOVE.B  #0,PCDR         TURN OFF DISPLAY
    00400472 00A00019
41  00400476 5302                   SUBQ.B  #1,D2           COUNT := COUNT - 1
42  00400478 67D0                   BEQ     REPEAT          IF 4TH DIGIT REPEAT CYCLE
43  0040047A E30B                   LSL.B   #1,D3           SELECT NEXT DIGIT
44  0040047C 60DA                   BRA     NEXT            DISPLAY NEXT DIGIT
45                         ********************************************************
46                         *DELAY SUBROUTINE
47  0040047E 383C09FF       DELAY   MOVE.W  #DELTIME,D4     SET DELAY [8]
48  00400482 5344           NEXTDEL SUBQ.W  #1,D4           COUNT DOWN TILL ZERO [8]
49  00400484 66FC                   BNE.S   NEXTDEL         [10/12]
50  00400486 4E75                   RTS                     RETURN FROM SUBROUTINE  [16]
51  00400500                        ORG     DATA            SEVEN SEGMENT PATTERNS
52  00400500 0001AD1A       NOMBOR  DC.W    $0001,$AD1A
53  00400504 3F065B4F       PATNS   DC.B  $3F,$06,$5B,$4F,$66,$6D,$7D,$07,$7F,$67,$77,$38,$39,$5E,$79,$71
    00400508 666D7D07
    0040050C 7F677738
    00400510 395E7971
54  00400514 00000000       DIGIT   DC.B    00,00,00,00     STORE FOR BCD DIGIT TO DISPLAY
55  004004A0                        ORG     TOTAL
56  004004A0 0000           SUM     DC.W    0
57  004004A2                        END
```

Figure 4 *[Rakah 4]* Seven-segments display program
(The numbers in bracket [ ] are the execution time)

[Aturcara pemaparan pemapar tujuh-ruas (Nombor dalam kurungan [ ] menunjukkan masa pelaksanaannya)]

...5/-

3. Figure 4 shows a listing file of a program for driving 4 seven segment display of Abitec microprocessor system in Applied Physics Lab USM.
[*Rajah 4 menunjukkan fail listing aturcara untuk memandu 4 pemapar tujuh ruas sistem mikropemproses Abitec di Makmal Fizik Gunaan USM.*]

a) What is the size (in byte counts) of the program?
[*Apakah saiz (dalam bilangan byte) aturcara tersebut?*]

(20/100)

b) What is the size (in byte counts) of the delay subroutine?
[*Apakah saiz (dalam bilangan byte) subrutin perlengahan?*]

(20/100)

c) What are the digits displayed on the seven-segment-displays when the program is executed and explain why those digits are displayed?
[*Apakah digit yang dipaparkan oleh pemapar-tujuh-ruas apabila aturcara dilaksanakan dan terangkan kenapa digit-digit tersebut dipaparkan?*]

(20/100)

d) Calculate the delay time generated by the delay subroutine if the speed of the microprocessor is 10MHz.
[*Kirakan masa pelengahan yang dijana oleh subrutin perlengahan sekiranya kelajuan mikropemproses ialah 10MHz.*]

(20/100)

e) Explain, what will be displayed on the seven-segment-displays if instruction 25-31 are removed from the program?
[*Terangkan, apakah yang akan dipaparkan oleh pemapar-tujuh-ruas sekiranya arahan 25-31 di buang daripada aturcara tersebut*]

(20/100)

4. Based on the program in Figure 4 solve the following problems:
[*Berdasarkan aturcara dalam Rajah 4 selesaikan permasaalahan berikut:*]

a) What is the difference between instruction BRA and BSR used in the program in Figure 4?
[*Apakah perbezaan antara arahan BRA dengan BSR yang digunakan dalam aturcara di Rajah 4?*]

(20/100)

b) What is the value in the Stack Pointer (SP) and stack location at the time the microprocessor executes the subroutine delay?
[*Apakah nilai penunjuk stack (SP) dan lokasi stack semasa mikropemproses melaksanakan subrutin perlambatan?*]

(20/100)

c) Why is opcode of BSR DELAY $61000012?
[*Kenapakah opkod BSR DELAY adalah $61000012?*]

(20/100)

d) What is the value of Program Counter (PC) immediately after the execution of instruction BSR DELAY?
[*Apakah nilai pembilang program (PC) sebaik sahaja selepas perlaksanaan arahan BSR DELAY?*]

(20/100)

e) What is the value of Program Counter (PC) immediately after the execution of instruction RTS?
[*Apakah nilai pembilang program (PC) sebaik sahaja selepas perlaksanaan arahan RTS?*]

(20/100)

```
 1                          *
 2  00B0000E                PSUIS   EQU     $B0000E          ;Switches Port
 3  00A0000E                LED     EQU     $A0000E          ;Led's Port
 4  00400400                MULA    ORG     $400400          ;Program location
 5  00400400 BB85                   EOR.L   D5,D5            ;Instruction    A
 6  00400402 2E7C0040               MOVE.L  #$4004FE,SP      ;Instruction    B
    00400406 04FE
 7  00400408 3A3900B0               MOVE.W  PSUIS,D5         ;Instruction    C
    0040040C 000E
 8  0040040E 3A3CABAD               MOVE.w  #$ABAD,D5        ;Instruction    D
 9  00400412 33C500A0       ULANG   MOVE.W  D5,LED           ;Instruction    E
    00400416 000E
10  00400418 4EF90040               JMP     ULANG            ;Instruction    F
    0040041C 0412
11  0040041E 4E4B                   TRAP    #11              ;Instruction    G
12  00400420 0000                   DC.W    0                ;Instruction    H
13  00400422                        END
```

Figure 5 [*Rajah 5*]

5. Figure 5 shows a listing file of test program in accessing the input port or output port of 68000 microprocessor system.
[*Rajah 5 menunjukkan fail listing aturcara ujian bagi mencapai port input atau port output sistem mikropemproses 68000*]

a) Identify the test program portion and calculate its size.
[*Kenalpasti bahagian aturcara pengujian tersebut dan kirakan saiznya.*]

(10/100)

b) Complete the timing diagram (in appendix) of the program portion.
[*Lengkapkan rajah pemasa (dalam Lampiran) bahagian aturcara tersebut.*]

(30/100)

c) By using multiple-input NAND gate and NOT gates, decode the switches and led's ports of the microprocessor system.
[*Dengan menggunakan get TAKDAN banyak input dan get TAK nyahkodkan port suis dan led system mikropemproses tersebut.*]

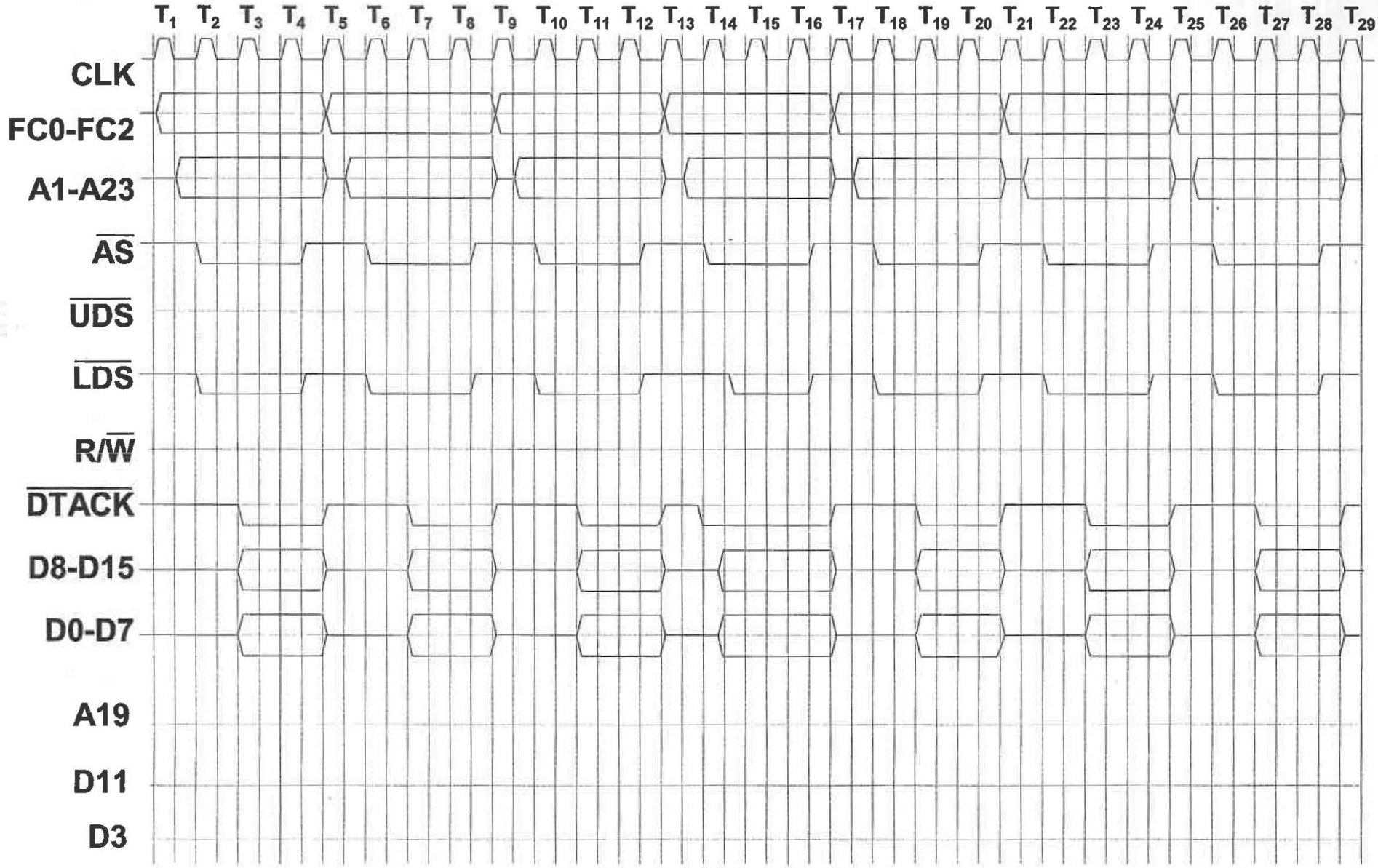
(30/100)

d) Modify or rewrite the program in Figure 5 so that we can see the input and output signals displayed on the logic analyzer screen.
[*Ubahsuai atau tulis kembali aturcara dalam Rajah 5 supaya kita boleh melihat kedua-dua isyarat input dan output di layar pemapar logik.*]

(30/100)

Angka Giliran: _____ No. Tempat Duduk: _____

Appendix



- 000 O 000 -