Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 1 **Introduction to the 8086/8088 Microprocessor**

A-Review questions:

1) What is the difference between the data bus of 8086 and 8088? Sketch the logical and physical memory for the 8086 and 8088.
2) How many lines exist in the 8086/8088 address bus? How many memory locations can be accessed by 8086/8088? How many Input/ Output devices can be accessed by 8086/8088?
3) State the address bus and data bus for the following processors:
   a-8086 b-8088
4) What is the function of the control bus?
5) How many bytes exist in 1kbytes in decimal? What is the difference between a nibble, byte, word and double word?
6) Illustrate by drawing the difference between a pipelined and non pipelined execution. What is the advantage of the pipelined execution?
7) Illustrate, with drawing, the basic internal architecture of the 8086/8088 microprocessors.

B-Answer the following questions:

Given an (16KB) RAM, starting from the address 0000h

1) How many address line does it require? Find its highest address?
2) The contents of memory location B00H are FFH and those at B01 are 00H. What is the word stored at address B00H?
3) How the double word 00567CFFH will be stored in memory starting at address 0A00H?

C) List the four general-purpose data registers. Explain their primary functions.

D) List the 8086/8088's internal registers used for memory segmentation.

E) Which of the following instructions cannot be coded in the 8086/88 assembly language:
   a-MOV AX,27
   b-MOV AL,978
   c-MOV DS , 9BF2
   d-MOV CX, 397

e-MOV SI,9516
f- MOV CS, 3490
g-MOV DS,BX
h-MOV BX,CS
i-MOV AX,DL

F) Show how the flag register is affected by

```
MOV AX,94C2H
MOV BX,323EH
ADD AX,BX
MOV DX,AX
MOV CX,DX
```

G) State whether the following statements are right or wrong and correct the wrong one:

1-The physical memory organization of the 8086 allows the transfer of 2 bytes in one operation while the 8088 can only transfer one byte in an operation.

2-The prefetch queue is a LIFO memory of 2 byte wide queue and 3 locations deep in the 8086 while it is one byte wide and 4 location deep in the 8088.

3-In the Flag register, if TF=0 then the 8086/8088 microprocessor operates in the normal mode.

Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 2 **Memory Segments and Physical Addressing**

1-Review questions:

a) How much memory can be active at a given time in the 8086/8088 microprocessor?
b) Which part of the memory address space is used to:
   1-Store instruction of a program?
   2-Store the data used by the program?
   3-Store temporarily data?

2- Calculate the physical address for each of the following cases:
a) CS = 2000H, IP = 1000H
b) SS = 1234H, SP = 0100H
c) DS = 1000H, BX = 0010H
d) The memory address 0100:1234H

3- Assume that BX = 4F56H, SP = 0100H and SS = 0200H. Explain what happens when the PUSH BX is executed.

4- Suppose that DS = 0200H, BX = 0200H and DI = 0300H. Determine the data memory address accessed by each of the following instructions:

a) MOV AL, [2000H]
b) MOV AL, [BX]
c) MOV [DI], AL

5-If CS=24F6H and IP=634AH, find:
a) The logical address
b) The physical address
c) The lower range of the code segment
d) The upper range of the code segment

6-Assume memory locations of the following contents:DS:6826=48 and DS:6827=22.Show the content of BX after the execution of the instruction MOV BX,[6826].

7-If SS=3500H and SP=FFFEH, calculate:
a) The physical address of the stack

b) The logical address of the stack
c) The lower range
d) The upper range

8- If CS=FFFFH, find the physical address of the lower range and upper range of the code segment.

9- If SS=0C00H and SP=FF00H, how many words of data are currently held in the stack if SP=0000H at the start of a certain program?

10- State whether the following statements are true or false:
a- To make full use of stack, we initialize SP=0000H.
b- Code segment can be overlapped with Extra segment.
c- Since there are four segments in the processor so the size of each one is calculated by dividing the total memory by four.
d- All registers can be saved into stack.
e- The stack is a FIFO memory.

11-If AX=3245H, BX=5632H, CX=672BH, CS=2000H, SI=62F4H, find the result of each line of the following program :(the memory map is shown below)
a-MOV DS,AX
b-MOV SI,100H
c-MOV BX,04H
d-ADD AX, [SI]

Memory location	data
32557H	2DH
32556H	24H
32555H	3CH
32554H	8BH
32553H	79H
32552H	6FH
32551H	6AH
32550H	34H

12- If AX=0000, BX=0010, CX=0020, DX=3034, CS=1200, DS=1000, ES=1030, SS=1060, BP=0040,
SP=0400, DI=0060, SI=0050, IP=0100, Find:
a-start and end of each segment.
b-physical address of top and bottom of stack.
c-how many bytes are pushed to stack.
d-physical address of the next instruction.

13- Convert the following decimal numbers to IEEE-754 short and long-form real numbers:
a) 10
b) - 11
c) 101.125

d) - 65.0625

Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 3 **Addressing Modes and Machine Language Coding of the 8086/8088 Microprocessor**

---

1) Identify the addressing modes, the source, and the destination operands in the following instructions:

   a) MOV DL, BL
   b) MOV AX, 00FFH
   c) MOV [DI], AX
   d) MOV DI, [SI]
   e) MOV [BX] + XYZ, CX
   f) MOV [DI] XYZ, AH
   g) MOV [BX][DI]XYZ, AL

2) What is wrong in the following instructions?

   a) MOV BL, CX
   b) MOV CS, SS
   c) MOV [BX], [DI]
   d) MOV [BX],10H

3) Identify the addressing modes, the source, and the destination operands in the following instructions:

   a)MOV AX,CX
   b)MOV AX,#1234H
   c)MOV AL,'A'
   d)MOV AL,[200H]
   e)MOV [300H],BL
   f)MOV [SI],BX
   g)MOV [BX+10H],AX
   h)MOV CX,[BP]+98H
   i)MOV [BP][DI],AH
   j)MOV AX,[DI][SI]
   k)MOV BX,[SI+20][BP]
   l)PUSH CX
   r)POP CS

4) Given that: DS = 1000H, SS = 2000H, BP = 1000H, DI = 0100H and LABEL = 1234H. Determine the data memory address and the addressing modes for each of the following instructions:

a) MOV AL, [BP][DI]+LABEL
b) MOV CX, [DI]
c) MOV DX, [BP]

5) Given that: DS = 1100H, BX = 0200H, LIST = 0250H and SI = 0500H. Determine the data memory addresses and the addressing modes for each of the following instructions:

a) MOV LIST[SI], DX
b) MOV BL, [BX][SI]+LIST
c) MOV BH, [BX]+LIST

6) Using the 8086/8088 instruction encoding tables, encode the following instructions:
a) MOV [DI], DX
b) ADD AX,DX
c) MOV [BX][SI], BX
d) MOV [BP],DL
e) MOV DL, [BX]+10H
f) PUSH DS
g) ROL BL, CL
h) MOV AX,1234H
i) MOV DX,[1000H]
j) MOV WORD PTR[BX],1000H

7) How many memory locations are required to encode the instruction MOV SI, 0100H?

8) How many bytes of memory are required to store the machine code for the following program, if this program is saved in the memory beginning from the address CS: 100H?

```
        MOV AX, 0100H
        MOV DS, AX
        MOV SI, AX
        MOV DI, 0300H
        MOV CX, 100
        MOV BL, 10
AGAIN:  MOV AL, [SI]
        ADD AL, BL
        MOV [DI], AL
        DEC CX
        JNZ AGAIN
        NOP
```

Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 4 **Introductions to Assembly Programming**

---

1) Describe the function of each of the following instructions:
   a) MOV BX, 03FFH
   b) LEA AX, DATA
   c) LDS DI, LIST
   d) LES BX, LIST
   e) PUSHF
   f) IN AL,0EEH

2) What is the difference between the two following instructions:

   a) MOV BX, DATA and LEA BX, DATA
   b) IN AL, 10H and IN AL, DX
   c) OUT 10H, AX and OUT DX, AX

3) Write a program that fills memory locations from 5000H to 5FFFH with value 77H.

4) Write a program that uses REP and MOVS to copy an array. Assume that the length of the array is stored at memory location 0400H, the original array starts at 0340H and the destination area starts at 360H. Run your program using:
   [0400H] = 03H, [0340H] = 4FH, [0341H] = 55H, [0342H] = 54H.

5) Write a program for the 8086 microprocessor that moves a block of data located in memory from address B0200 to address B02F9 to a new location starting at address B0600.The contents of the Data segment register DS is to be B000.

6) a) Write a program that forms a lookup table originated at 380H of the squares of the decimal digits from zero to 8d.

   b) Use the formed table in (a) to square the digit in 400H and place the square in 401H. Run your program using:
      i) [400H] = 04H
      ii) [400H] = 07H

   c) Write a program that uses the table in (a) to add the squares of 400H and 401H and put the sum in 402H. Run the program using: [400H] = 03H and [401H] = 06H.

7) What is wrong with the following instructions?
   a) ADD CL, AX.
   b) INC [BX].

c) ADD [BX],12H

8) Find the result of IDIV BL if
   a)AX=0010H and BL=FDH
   b)AX=-16d and BL=3d

9) Write the instruction that performs the following operations:
   a) AND BX with DX and save the result at BX.
   b) AND the data stored 4 words before the location addressed by SI with DX and save the result in DX.
   c) OR 1122H with BP.
   d) OR AH with memory location WHEN and save the result in WHEN.
   e) XOR the data addressed by BX and DX and save the result in memory.
   f) XOR the data stored 30 words after the location addressed by BP with DX and save the result in DX.

10) Develop a short sequence of instructions that perform the following operations:
   a) Add the contents of AL, BL, CL, DL and AH and save the result in DH.
   b) Subtract the numbers in DI, SI and BP from the AX register and store the difference in BX.
   c) Cube the 8-bit number found in CL, assuming that CL contains a 5 initially.
   d) Divide the number in BL by the number in CL and then multiply the result by 2.
   e) Save the content of AL in BX as word.
   f) Implement the following equation: 7(AL)-5(BL)-(DX)/8 and store the result in AX.(Assume that DX is divisible by 8).
   g) Set the rightmost 4 bits of AX, clear the 4 leftmost bits of AX and invert bit positions 7, 8 and 9 of AX.
   h) Scan through a section of byte memory called for a 66H.

11) Two 32 bits numbers, one is stored at DS: 200 and the other at DS: 100.Write a program to add these two numbers and stores the result at DS: 300

12) Write a program that add 2 hexadecimal digits stored in memory location DS: 100 as one byte.

13) Write a program that adds an array of unsigned 8-bit numbers starting at 340H and puts the sum in 400H. The length of the array is in 401H. Run the program with the following data: [401] = 04H, [340H] =3EH, [341H] =47H, [342H] =F5H, [343H] =2AH.

14) Write a program that adds an array of unsigned 16-bit numbers starting at 340H and puts the sum in 400H. The length of the array is in 401H. Run the program with the following data: [401] = 02H, [340H]=36H, [341H]=21H, [342H]=97H, [343H]=18H.

15) Write a program to calculate factorial N (given N = 7).

16) Write a program that stores the BCD numbers in the memory starting at address 340H. Then the program doubles each element and stores the results in the same memory location.

17) Write the instruction that performs the following operations:

a) Shift DI right 1 place with a 0 moved into the leftmost bit position.
b) Move all the bits in AL left 1 place making sure a 0 moves into the rightmost bit position.
c) Rotate the bits left 1 place in SI.
d) Rotate through carry DX 1 place to the right.
e) Move the DH register right 1 place with the sign bit shifted through DH.

18) If AX=6F55H, DS=3245H and CX=0100H, find the change in AX after the execution of each of the following lines and the value of CX at the end of the program

a) MOV AX,1234H
b) MOV BX ,AX
c) NOT AX
d) AND AX,BX
e) OR AX ,BX
f) XOR CX,CX
g) MOV CL,02H
h) SHL AX,CL
i) SAR AX,CL
j) RCL AX,CL

19) Write an assembly program to sort 100 unsigned numbers stored in memory starting at address 30B50H in an ascending order.

20) Without using MUL/IMUL instruction, write a sequence of instructions that multiply AX with:
a) 4d b) 10d

21) Write a program to convert the 16 bit binary content of AX to a four digit ASCII character .Assume that AX=00F5H (F5H=245 d) and the result will be saved in AX and DX.

Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 5 **Introduction to Hardware and Memory Address Decoding**

---

1) a) What is the purpose of the ALE line in the 8088/8086?

b) Why are buffers and latches needed for the data, address and control buses of the 8088/8086 microprocessors?

c) Draw the demultiplexing and buffering circuits for the 8088 and 8086 microprocessors.

d) Why are memory address decoders important?

e) Using 64Kx8 SRAMs, determine the number of chips required to construct a memory interface to each of the following processors:

i) 8088 ii) 8086 iii) 80486 iv) Pentium

f) Sketch the bus timing waveform of a READ machine cycle for the 8086 processor.

g) The pinout of the 8284A and its internal circuitry is shown in figure 1 .Answer the following questions:

i) Which pin is connected to the clock of the microprocessor? If a crystal of 15 MHz is attached at pins 16 and 17, what is the operating frequency of the processor? If a memory chip of access time of 500ns is interfaced with the processor, does it requires a wait state? Why? Which pin is responsible for the generation of the READY signal? Which pins are used to control the generation of the READY signal?

ii) Explain briefly how the clock signal is generated by two different methods using the pins (X1, X2, F/C, EFI and CLK)? If you need three chips of the 8284A clock generator, how many crystals do you have to buy to operate the three ICs? Explain your answer.

iii) Draw a simple circuit that can be used to generate READY signal with (0-7) wait states.

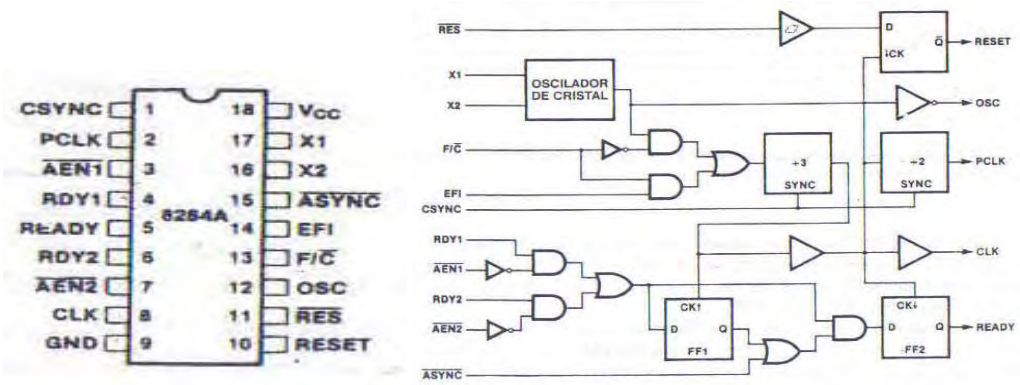


Figure 1.

2) For the shown memory in figure 2, find the range of addresses for each chip. If the 3-8 decoder 74138 is removed and we used a PAL 16L8 instead, draw the new circuit, and write down the equations describing the connections.

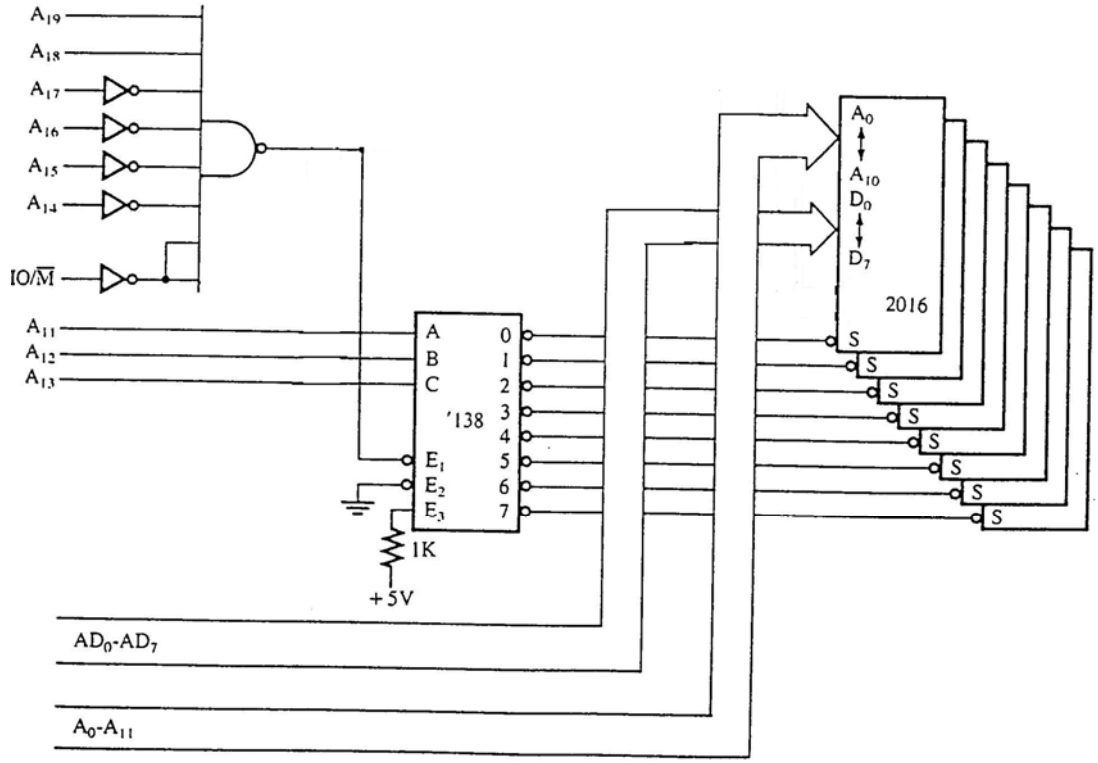


Figure 2.

3) Design a circuit showing how to interface 2732 EPROMs to the 8088uP using 74LS138 so that the memory range from 68000H – 6BFFFH is addressed.

4) Design a circuit showing how three 2732 EPROMs and two 2716 EPROMs to the 8088 microprocessor using one 74LS139 so that the memory range from 00000H – 03FFFH is addressed.

5) Design a memory system for the 8088 microprocessor consisting of:

a) ROM section using 2732 chips for the addresses from 00000H-02FFFH

b) RAM section using 4016 chips for the addresses from 06000H-06FFFH

6) Design a circuit showing how to interface 2732 EPROMs to the 8086 microprocessor using 74LS138 so that the memory required is 64KB starting at the address B0000H.

7) a) Sketch in detail the memory bus cycle for the 8088 microprocessor. If the processor is clocked at 5MHz, what is the maximum data rate of the 8088 data bus?

b) Consider an 8088 microprocessor with the following memory map. Design a decoding circuit to select the RAM0, RAM1 and ROM0 devices which consists of 2Kx8 chips. Use 74138 type devices (two low active enables and one high active enable) and any other standard logic gates

ROM	0C000-0FFFFH
MEMORY MAPPED IO	08000-0BFFFH
RAM1	04000-07FFFH
RAM0	00000-03FFFH

8) a) Modify the circuit shown in figure 3 so that the EPROM is located at the memory address starting at B0000H and the RAM is located at the memory address starting at 10000H

b) Modify the new circuit so that the memories are doubled and starting at the same addresses

c) Modify the circuit in b) so that it can be connected to Pentium processor.

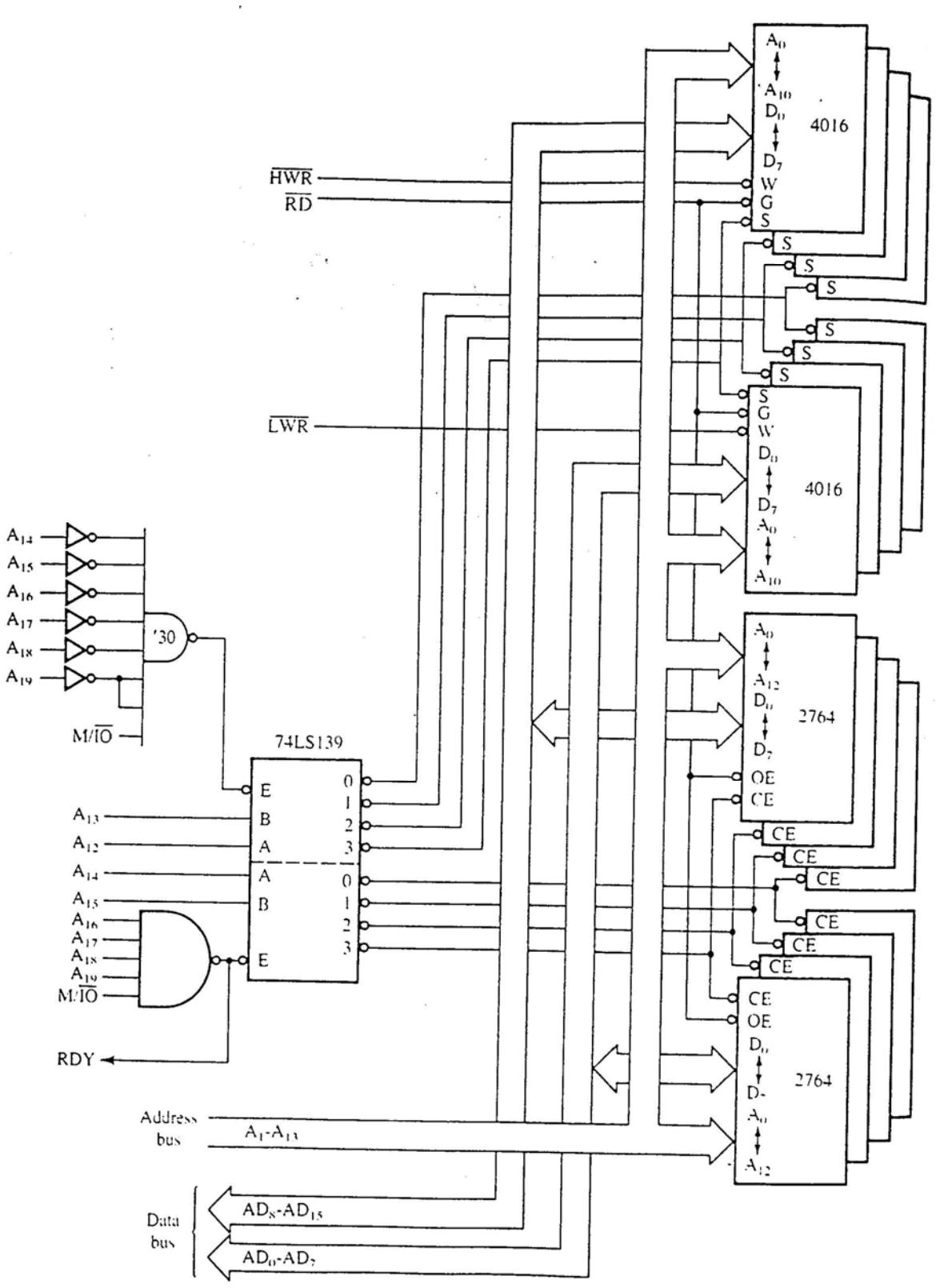
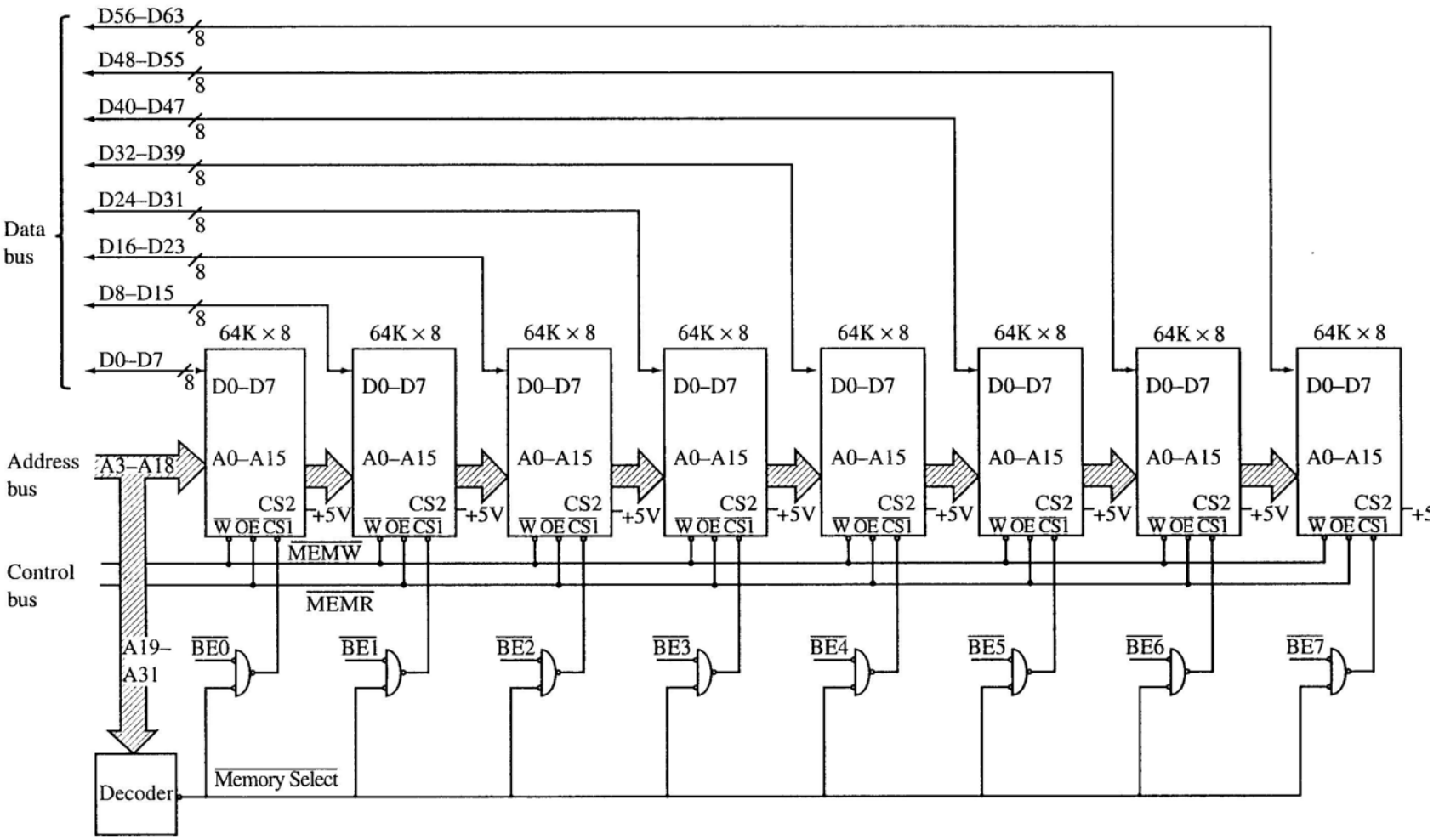

HWR
RD
LWR
4016
4016
2764
2764
S
G
W
CE
OE
'30
74LS139
M/IO
RDY
Address bus
A1-A13
Data bus
AD8-AD15
AD0-AD7

Figure 3.

9) a) It is required to connect an 8088 to 8 ROM chips of 8KB each , starting at address A0000H.Show the connection indicating the range of addresses of each chip
b) Modify the circuit shown in figure 4 so that the Pentium processor is interfaced with 8 1MBx8 chips
c) If a 74138 decoder is used to connect the circuit in b) with starting address F0000000H, show the connection lines to the decoder.

512K × 8 Pentium SRAM interface.



10) Find the CRC bytes for the data stream 4D92H using the generator polynomial $x^{16}+x^{15}+x^2+1$.

Alexandria University
Faculty of Engineering
Communications and Computers SSP

Course: Microprocessors CC421 **Instructor:** Dr.M.El-Banna
Academic Year: 2016 – 2017 **Assistant:** TBA

Spring Semester

SHEET 6 Basic Input Output, Interrupts and Memory Hierarchy

1) Review Questions:

   a) What is the difference between Memory mapped I/O and Isolated I/O?

   b) What are the three modes for the operation of 82C55? What is meant by Handshaking?

   c) How many counters exist in 8254? What is the maximum input frequency for each counter? What are the main functions of the 8254? Sketch the internal architecture of the 8254A.

   d) State whether the following sentences are right or wrong and correct the wrong one if possible:

   i) The instructions IN and OUT are used in the Isolated I/O method and cannot be used in the Memory Mapped I/O method.

   ii) The 8255 requires a Wait state if the processor is clocked at higher than 10 MHz while the maximum clock input to any counter in the 8254 is 8MHz.

   iii) The memory hierarchy is a mechanism of comparing the cost and performance of the different memories used to store data and instructions.

2) Write the necessary assembly instructions to load the appropriate control word (shown below) to program the PPI 8255 for the I/O configuration shown in figure 1 then read the input byte from Port A and add it to the byte read from Port B then output the result from Port C .Please reset all the do not care bits in the address to zeros if exist.

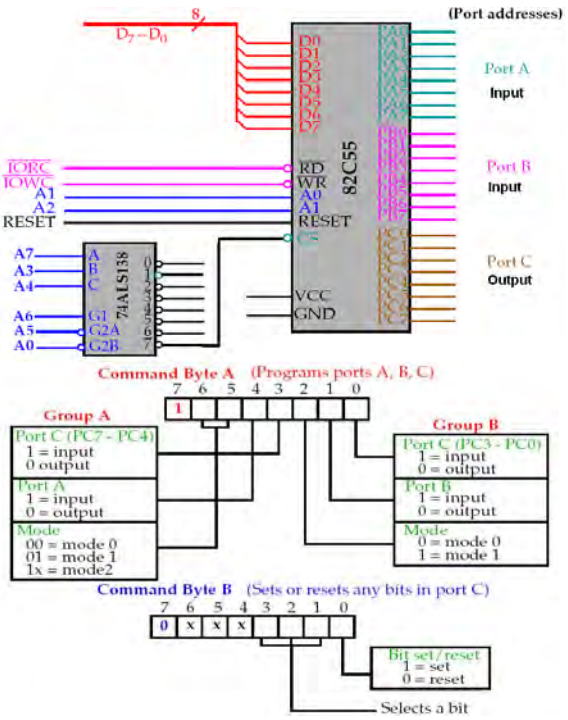
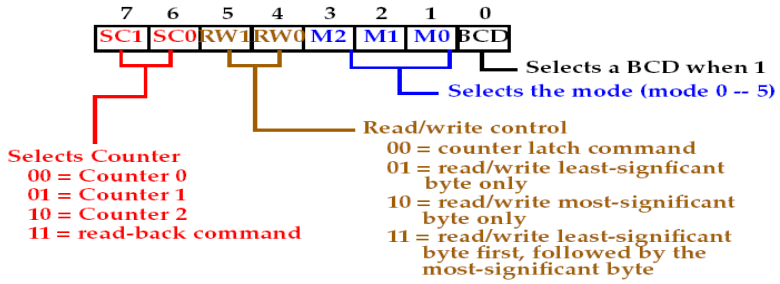


Figure 1.

3) a) Modify the circuit shown in figure 1 so that the 8255 functions at I/O ports 20-23H (Show modifications only).
b) Program the 8255 in mode 0 so that Port A is an output port, Port B is an input port and Port C is an output port.
c) Program again the 8255 PPI so that Port A is an input port with handshake and Port B is a simple input port.
d) Draw a decoding circuit to connect the 8086 microprocessor to two 8255 chips to input or output 16-bit data .Write the port addresses that you have chosen for each chip.

4) Program counter 1 of the 8254 so that it generates a continuous series pulses that have a high time of 100ms and a low time of 1ms .Indicate the clock frequency required for this task .You may use the two figures below for configuring the 8254 chip.(Use figure 2).



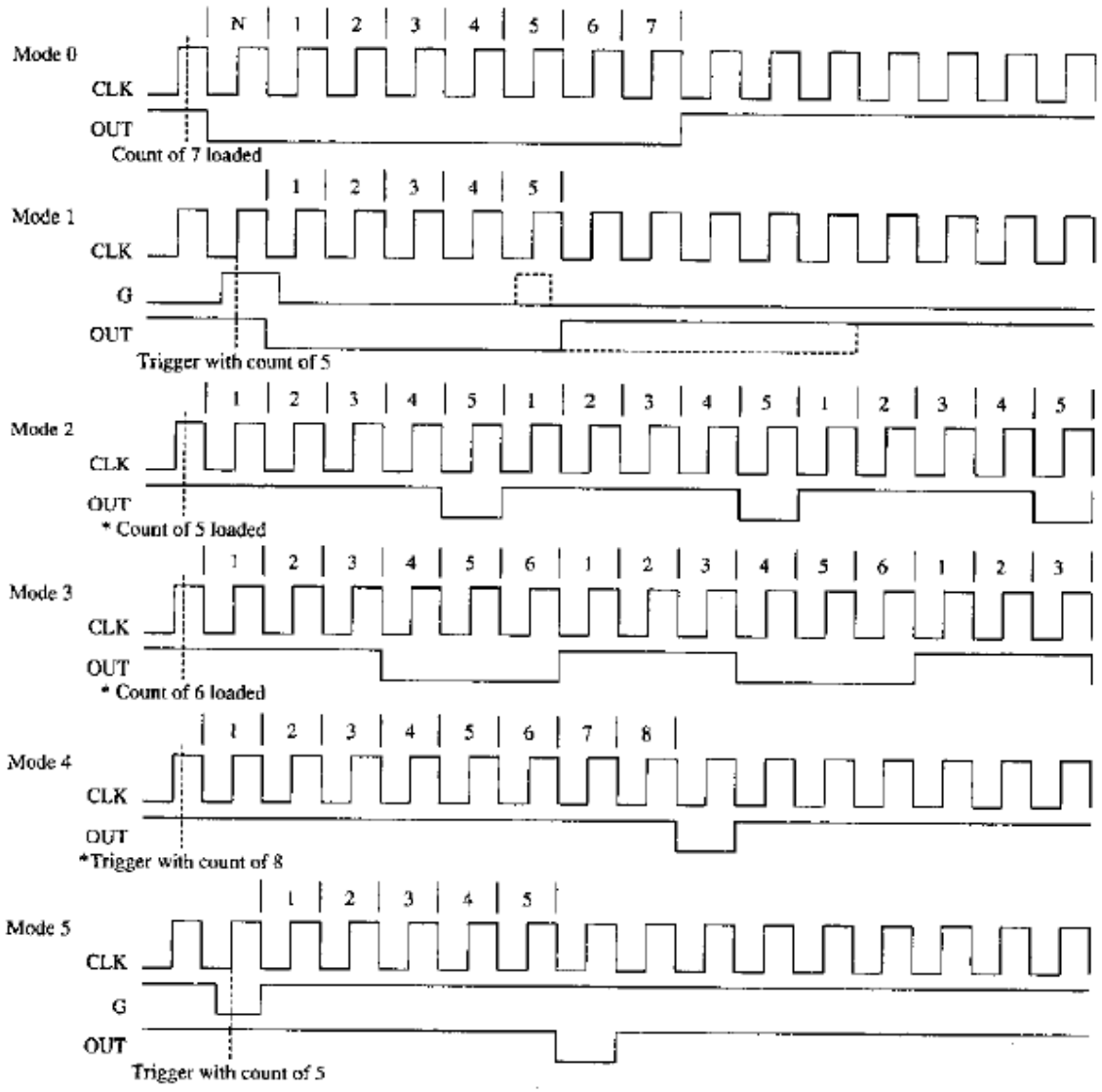


Figure 2.

5) Interface an 8254 so that it resides at I/O port F0-F3H for an 8088.Write a program for counter 1 to generate a 2Khz square wave if the clock input is 5Mhz. You may use the two figures above for configuring the 8254 chip. (Use figure 2).