COMSATS - Lancaster Dual Degree Programme
COMSATS Institute of Information Technology Lahore

Terminal – Fall 2014

Course Title:	Microprocessor Systems and Interfacing				Course Code:	EEE342	Credit Hours: 4(3,1)
Instructor:	Engr. Usman Rafique, Engr. Saqib Salahuddin				Programme:	BS (Telecommunication Engineering) BS (Computer Engineering)	
Semester:	6th	Batch:	SP12-BTE+BCE	Section:	BTE-A+B, BCE	Date:	
Time Allowed:	180 Minutes				Maximum Marks:	100	
Student's Name:					Reg. No.	CIIT/DDP- /LHR	

Important Instructions / Guidelines:

- Answer all the questions on answer book in the same order as they are asked in question paper.
- Draw neat and clean figures wherever asked.
- Return this question paper along with answer book.
- Cell phones are not allowed to keep with you even when they are switched off.

Question 1 — 20 Marks

a. If a processor clock speed is 20MHz and it can perform 2.5 million read/write operations in 1 second. Determine the number of clock cycles in a single bus cycle for the processor. (5)

b. For DS = 0008H and SI = 0A2FH (10)
In protected memory mode, identify the descriptor selected by the DS register from the figure 1 and find out the starting and ending address of the segment, the type of the segment described by the selected descriptor. Also find out the memory location addressed by the above combination of registers.

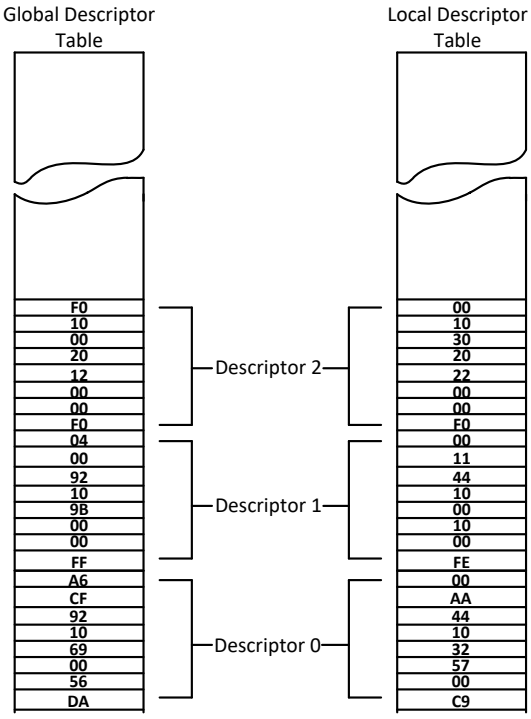


Fig. 1

c. We have discussed the superscalar processors in classroom. Highlight main features of superscalar processors being developed these days. (5)

Question 2 20 Marks

Block diagrams of a 32K × 8 RAM and a 3-to-8 Decoder is given below. Using **Separate-Write Strobes** technique in an **8086** microprocessor-based system

a. Draw a schematic for a 128K × 8 section of memory. (10)
b. The staring address of the memory should be A0000H. (05)
c. Also find out the address ranges for each memory component. (05)

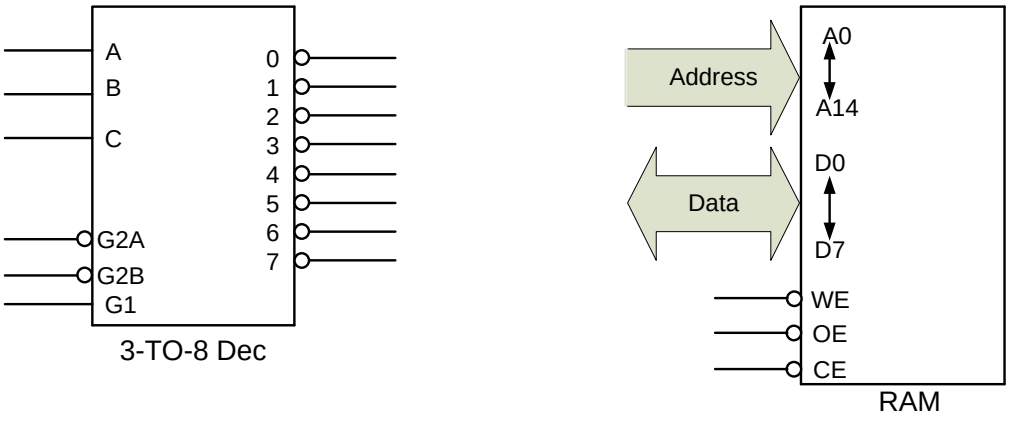


Fig. 2

Question 3 20 Marks

The given diagram in figure 3 shows a portion of program memory with machine code of three instructions. Using the tables given at the end of question paper convert the machine code stored in the memory into assembly instructions. (Where opcode of MOV = 100010 and MOV (immediate) = 110001)

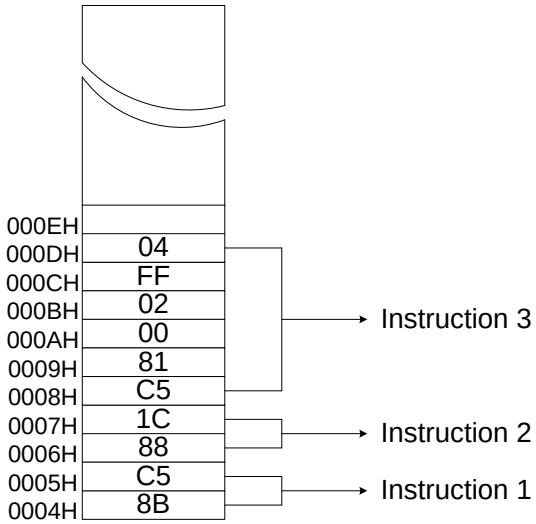


Fig. 3

Question 4 20 Marks

a. Interface a four-pole stepper motor with lower half-byte of 8255 PPI PortA. PPI is to be interfaced with 8088 CPU from CCH and above. You are required to provide completely labelled schematic diagram of CPU, PPI and stepper motor hardware. (10)
b. Following 8088 assembly language program drives a stepper motor connected with an output port. Stepper motor that is driven through this software covers 1.8 degrees in one complete step. Read this program carefully and answer the questions following it. (10)

Program:

```
START:
            MOV   CX, 10
NEXT:       CALL  REV_1
            LOOP  NEXT
            HLT
REV_1:
            MOV   CX, 4
            MOV   BH, 8
AGAIN:
            MOV   BL, BH
            MOV   AL, BL
            SHR   BL, 1
            OUT   100, AL
            OR    AL, BL
            OUT   100, AL
            SHR   BH, 1
            LOOP  AGAIN
            RET
```

i. What is the port number at which stepper motor is interfaced?
ii. Which half (upper or lower) of output port is interfaced with stepper motor?
iii. How many degrees does stepper motor cover when subroutine **`REV_1`** is executed once?
iv. How many degrees does stepper motor cover just before execution of **`HLT`** instruction?
v. In the first instruction, what should be the value in CX so that motor rotates 180 degrees?

Question 5 20 Marks

a. Assume your registration number has been pushed on to the stack in an 8088 CPU system in the following given format and stack pointer is currently holding 7255H just after pushing last value in your registration number. Segment address for stack is CD12H. You are required to write an assembly language program that pops your registration number off the stack and prints it to the monitor. (14)
Reg. number example format: DDP_SP12_BTE_A_123

b. Write an 8086-88 assembly language program that reads a character from keyboard and after taking its complement, writes it to the port with port number ABCDH. (6)

Table 1

MOD	*Function*
00	No displacement
01	8-bit sign-extended displacement
10	16-bit displacement
11	R/M is a register

Table 2
MOD field for 16-bit Instruction mode

Code	*W=0 (Byte)*	*W=1 (Word)*	*W=1 (Doubleword)*
000	AL	AX	EAX
001	CL	CX	ECX
010	DL	DX	EDX
011	BL	BX	EBX
100	AH	SP	ESP
101	CH	BP	EBP
110	DH	SI	ESI
111	BH	DI	EDI

Table 3
REG and R/M (when MOD = 11) assignments

R/M code	*Addressing Mode*
000	DS:[BX+SI]
001	DS:[BX+DI]
010	SS:[BP+SI]
011	SS:{BP+DI]
100	DS:[SI]
101	DS:[DI]
110	SS:[BP]*
111	DS:[BX]

Solution Key

Question 1

a. Total speed = 20 MHz
Total operations = 2.5 million = 2500000
Bus clock cycle = 20 M / 2500000 = 8 clock cycle

b. The DS register will select descriptor 1 from global descriptor table. (2)
The starting address of the segment = 04109B00 h (1)
Limit of segment = 000FF h (1)
Access byte = 92 = 1001 0010
The segment is defined with DPL = 00. It's a normal data segment in which data may be written. The segment has not been accessed before. (4)

The current memory address = 0410A52F h (2)

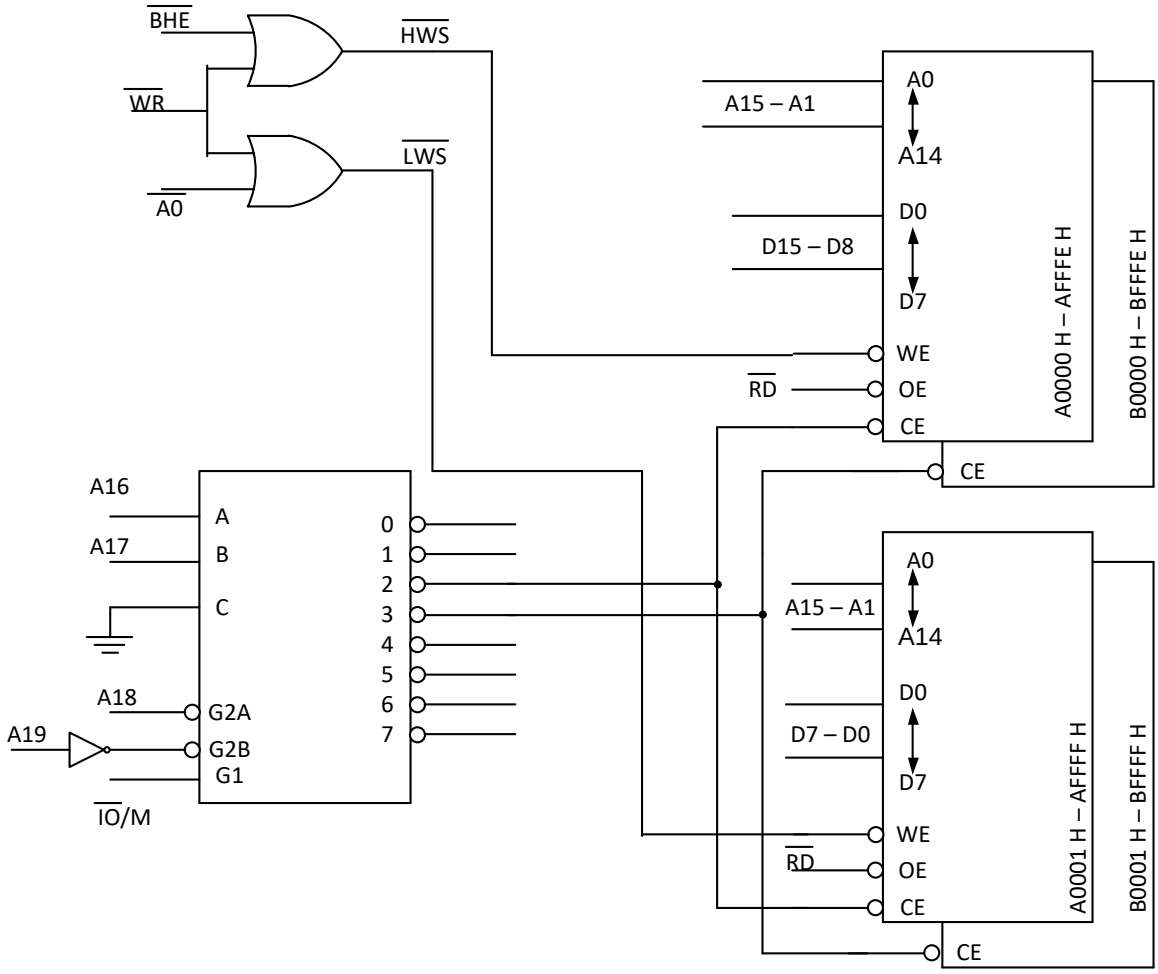
c. We have discussed the superscalar processors in classroom. Highlight main features of superscalar processors being developed these days.

- A superscalar CPU can execute more than one instruction per clock cycle. (2 Marks for each)
- A superscalar architecture includes parallel execution units, which can execute instructions simultaneously.
- Multiple instructions are fetched, despatched and executed simultaneously in different hardware units.
- Because of their superscalar capabilities, RISC processors have typically performed better than CISC processors running at the same megahertz.
- Nearly all processors developed after 1998 are superscalar.

Question 2 20 Marks

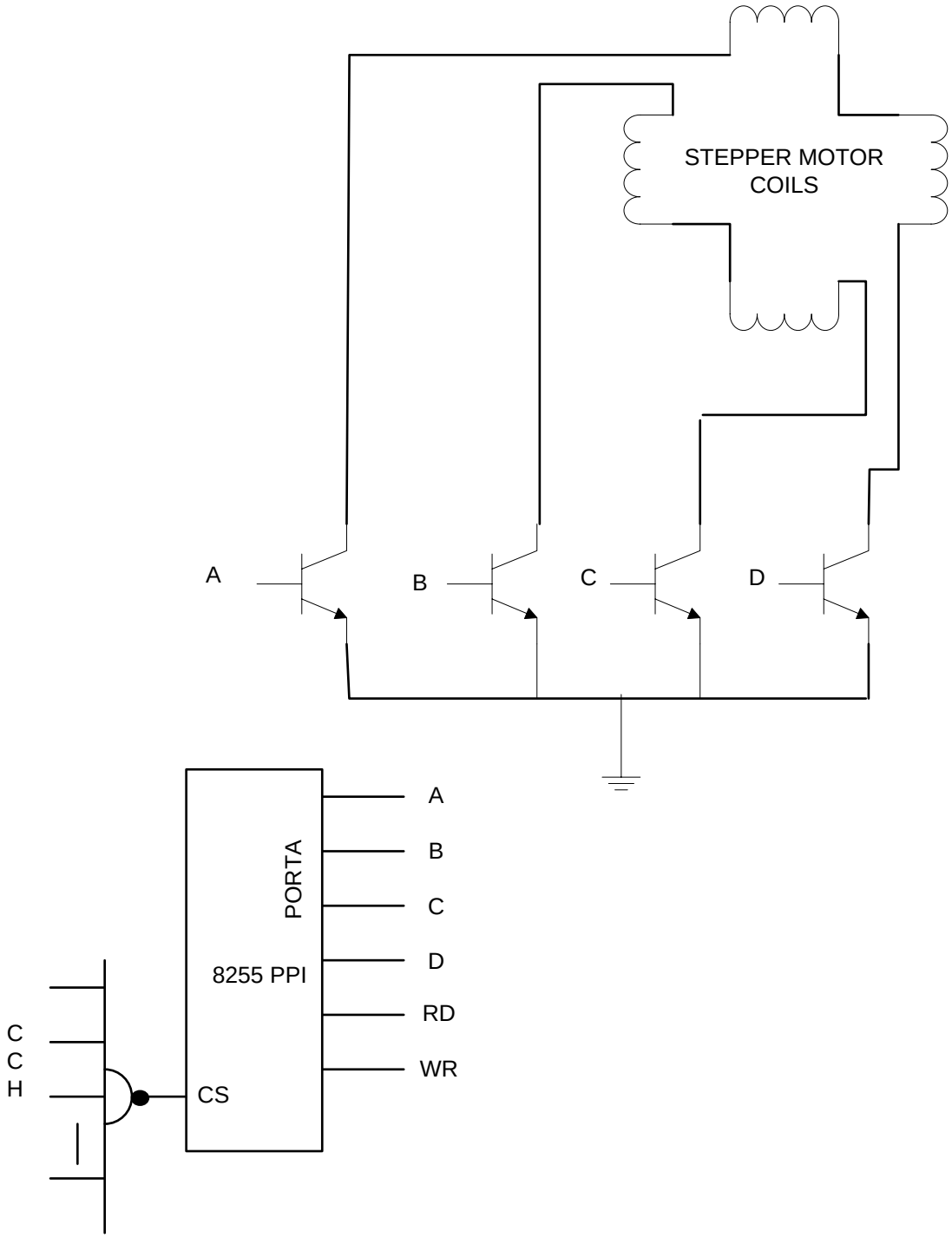
Block diagrams of a 32K × 8 RAM and a 3-to-8 Decoder are given below. You are required to draw a schematic for a 128K × 8 section of memory using **Separate-Write Strobes** technique in an **8086** microprocessor-based system which has a 16 bit data bus. The staring address of the memory should be A0000H. Also find out the address ranges for each memory component.

Complete diagram 15 marks
Address calculation 5 marks



Question 4 20 Marks

a. Interface a four-pole stepper motor with lower half-byte of 8255 PPI PortA. PPI is to be interfaced with 8088 CPU from CCH and above. You are required to provide completely labelled schematic diagram of CPU, PPI and stepper motor hardware. (10)



b. Following 8088 assembly language program drives a stepper motor connected with an output port. Stepper motor that is driven through this software covers 1.8 degrees in one complete step. Read this program carefully and answer the questions following it. (10)

Program:

```
START:
            MOV   CX, 10
NEXT:       CALL  REV_1
            LOOP  NEXT
            HLT
REV_1:
```

```
                MOV   CX, 4
                MOV   BH, 8
        AGAIN:
                MOV   BL, BH
                MOV   AL, BL
                SHR   BL, 1
                OUT   100, AL
                OR    AL, BL
                OUT   100, AL
                SHR   BH, 1
                LOOP  AGAIN
                RET
```

i. What is the port number at which stepper motor is interfaced?

100 = 64H

ii. Which half (upper or lower) of output port is interfaced with stepper motor?

Lower half (3…0)

iii. How many degrees does stepper motor cover when subroutine **REV_1** is executed once?

7.2 degrees

iv. How many degrees does stepper motor cover just before execution of **HLT** instruction?

72 degrees

v. In the first instruction, what should be the value in CX so that motor rotates 180 degrees?

25 = 19H

Question 5 20 Marks

a. Assume your registration number has been pushed on to the stack in an 8088 CPU system in the following given format and stack pointer is currently holding 7255H just after pushing last value in your registration number. Segment address for stack is CD12H. You are required to write an assembly language program that pops your registration number off the stack and prints it to the monitor. (14)

Reg. number example format: DDP_SP12_BTE_A_123

```
                MOV         CX, 18
                XOR         SI, SI
        READ:   MOV         AX, 0CD12H                  (3)
                MOV         SS, AX
                POP         AX
                MOV         BX, 1000H                   (3)
                MOV         DS, BX
                MOV         [SI], AL
                INC         SI                          (4)
```

```
LOOP    READ
MOV     [SI], '$'
MOV     DX, 00H
MOV     AH, 9
INT     21H                    (4)
```

b. Write an 8086-88 assembly language program that reads a character from keyboard and after taking its complement, writes it to the port with port number ABCDH. (6)

```
MOV     AH, 01H                (2)
INT     21H
NOT     AL                     (2)
MOV     DX, 0ABCDH
OUT     DX, AL                 (2)
```