

# **KABARAK**

# UNIVERSITY

# UNIVERSITY EXAMINATIONS 2010/2011 ACADEMIC YEAR FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE

**COURSE CODE: COMP 451** 

COURSE TITLE: MICROPROCESSOR-BASED SYSTEMS

STREAM: Y4S1

DAY: THURSDAY

TIME: 9.00 - 11.00 A.M

DATE: 16/12/2010

#### **INSTRUCTIONS:**

- Answer Question **ONE** and any other **TWO** Questions. Question One carries 30marks while each of the other Two Questions carry 20marks.
- The 8085 Instruction set is appended.

#### PLEASE TURNOVER

# **QUESTION 1 (30 marks)**

a) Perform the following arithmetic

**(4mks)** 

- i). 0CDFH + 0ABCH
- ii). 00001000 00000011
- b) i) What is a microprocessor?

(1mk)

ii) State two basic operations of a microprocessor

(2mks)

- c) Explain briefly the functions of the following register units in the 8085 microprocessor. (3mks)
- i.) Stack pointer
- ii.) Timing and control
- iii.) Instruction register and decoder
- d) i) What is an interrupt?

(1mk)

ii) State any two classifications of 8085 microprocessor pins

(2mks)

e) i) What is memory?

(1mk)

ii) A memory chip has a capacity of 4K byte, how many address lines does it have?

(1mk)

- iii) State two groups of classifying memories. State one example of each class of memory (3mks)
- f) Explain briefly what the following means as used with microprocessors.

(3mks)

- i.) Branch instructions
- ii.) Interrupts
- iii.) Subroutine
- g) Write down an assembly language program of adding two numbers 234H and 566H using 8085 instruction set (3mks)
- g) Differentiate between the following
  - i). Instruction set and addressing modes

**(2mks)** 

ii). Register addressing mode and register indirect addressing mode with respect to 8085 microprocessor. Write a short 8085 instruction example to illustrate the difference between the two addressing. (4mks)

### **QUESTION 2 (20 marks)**

- a) Differentiate between the following
- i.) Machine code programming and assembly language programming (2mks)
- ii.) The assembler program and the compiler program

(2mks)

- b) Write an algorithm for adding odd numbers between 0 and 20 for the 8085 microprocessor. Develop your program as follows
- i.) Outline the steps followed. Use registers A, B and C

(2mks)

- ii.) Assuming the first memory location is 26DDH; write the assembly language program to perform this operation using appropriate 8085 instruction set. Show also memory contents in hex codes. (4mks)
- iii.) Simply your program in (ii) using a flow chart

(**3mks**)

c) i) Hand assemble the given assembly language program of 8085 microprocessor assuming that the first memory locations is 0066H. (5mks)

START: MVI B, 4FH MVI C, 78H MOV A, C OUT 07H CALL DEL MVI A, 8FH MVI B, 68H SUB B ANI 0FH STA 2070H CALL DEL AGAIN: IN F2H **CMA** ORA A JZ AGAIN DEL: LXI D, 00FFH REP: DCX D MOV A, E ORA D JNZ REP RET

ii) State the address of the following in the hand assembled program

(2mks)

- I) DEL label
- II) STA instruction

### **QUESTION 3 (20 marks)**

- a) i) What is interfacing? (1mk)
  - ii) State and explain two types of interfaces. (3mks)
  - iii) State and explain two features that need to be considered when selecting an interface circuit (2mks)
- b) i) State and explain two modes of operation of 8255 PPI (2mks)
  - ii) Present the control word format of 8255 PPI (3mks)
- c) A microprocessor-based system uses the 8255 PPI as its I/O device. If this system is to be used to read bit pattern from port B and output the same to port A and Port C continuously and endlessly;
- i) Write an assembly language program to perform this operation using appropriate 8085 instruction set. Assume that the first memory location is 78EFH and use a delay constant of FDEFH between the outputs in register pair DE.

(6mks)

- ii) State the memory address of the last byte of the instruction in (i) above (1mk)
- iii) State two advantages of using mnemonics as opposed to binary values or hex codes.

(2mks)

#### **QUESTION 4 (20 marks)**

- a) State and use flow charts to show the three standard structures used to represent the operations involved in program writing (3mks)
- b) Distinguish between the following

**(4mks)** 

- i). Algorithm and program
- ii). Assembler and compiler
- c) State three things that a microprocessor should do in order to communicate with a memory or I/O device. (3mks)
- d) i) State and explain two way of memory expansion

(2mks)

- ii) By considering suitable memory sizes, show using a block diagram how the above schemes of memory expansion can be achieved (2mks)
- e) State and explain using instruction example in each case, the classification of 8085 instruction set sizes. (6mks)

#### **QUESTION 5 (20 marks)**

a) i) What is a microprocessor-based system

(1mk)

ii) Outline the components required for the design of a microprocessor-based system.

**(2mks)** 

iii) Give in block diagram how the components in (ii) are organized to form the system. (3mks)

c) i) What is stack? How is it specified?

(2mks)

ii) What is bus contention problem? How is this situation prevented?

(2mks)

d) Consider the following assembly language program of a microprocessor-based system using the 8255 PPI.

MVI A, 80H

OUT 03H

START: MVI A, AAH

OUT 00H

OUT 01H

OUT 02H

**CALL SUBTASK** 

MVI A, 55H OUT 00H

OUT 01H

OUT 02H

CALL SUBTASK

JMP START

SUBTASK: LXI D, FFDFH

AGAIN: DCX D

MOVA, E ORA D

JNZ AGAIN

**RET** 

i.) Suggest what the first two instructions is doing

(2mks)

ii.) Name the labels used in this program and state their importance

(2mks)

iii.) Suggest what the whole program is doing

(2mks)

iv.) Hand assembles the above program showing only two columns of address and memory contents in hex codes. Assume the first memory location is 489EH.

**(4mks)** 

# **THE 8085 INSTRUCTION SET**

CE         ACI         N         3D         DCR         A         7E         MOV         A.M           8F         ADC         B         0D         DCR         C         40         MOV         B.B           88         ADC         B         0D         DCR         C         40         MOV         B.B           8A         ADC         C         15         DCR         D         41         MOV         B.B           8B         ADC         E         25         DCR         H         43         MOV         B.F           8C         ADC         L         25         DCR         H         44         MOV         B.H           8D         ADC         L         35         DCR         M         45         MOV         B.B           8E         ADC         L         35         DCR         M         45         MOV         C.A           8B         ADC         L         48         MOV         C.B         B.M         MOV         C.C           82         ADD         D         F3         DI         4A         MOV         C.C           84         ADD	CE	A CT	N	2D	DCD	Λ	7E	MOV	A N/I
88         ADC         B         0D         DCR         C         40         MOV         B.B           89         ADC         C         15         DCR         D         41         MOV         B.C           8A         ADC         D         11D         DCR         E         42         MOV         B.D           8B         ADC         E         25         DCR         H         43         MOV         B.B           8D         ADC         H         2D         DCR         L         44         MOV         B.B           8D         ADC         L         35         DCR         M         45         MOV         B.L           8E         ADC         M         0B         DCX         B         46         MOV         C.A           80         ADD         A         1B         DCX         D         4F         MOV         C.A           81         ADD         B         2B         DCX         H         48         MOV         C.C           82         ADD         D         FB         EI         44         MOV         C.C           82         ADD									
SP									
8A         ADC         D         IID         DCR         E         42         MOV         B,D           8C         ADC         E         25         DCR         H         43         MOV         B,E           8D         ADC         H         2D         DCR         L         44         MOV         B,H           8D         ADC         L         355         DCR         M         45         MOV         B,L           8D         ADC         M         08         DCX         B         46         MOV         C,A           80         ADD         A         IB         DCX         D         4F         MOV         C,A           80         ADD         B         DCX         H         48         MOV         C,B           81         ADD         D         FB         DI         4A         MOV         C,C           82         ADD         D         FB         DI         4A         MOV         C,C           83         ADD         L         DB         IN         N         4D         MOV         C,C           84         ADD         L         TB									
8B         ADC         E         25         DCR         H         43         MOV         B.E           8D         ADC         H         2D         DCR         L         44         MOV         B.H           8D         ADC         L         35         DCR         M         45         MOV         B.H           8E         ADC         M         08         DCX         B         46         MOV         B.M           80         ADD         B         1B         DCX         D         4F         MOV         C.C           81         ADD         B         2B         DCX         H         48         MOV         C.C           82         ADD         D         F3         DI         4A         MOV         C.C           83         ADD         E         FB         E         E         4B         MOV         C.D           84         ADD         H         76         HLT         4C         MOV         C.H           85         ADD         L         DB         IN         N         4D         MOV         C.L           86         ADD         M									
SC         ADC         H         2D         DCR         L         44         MOV         B.H           8E         ADC         L         35         DCR         M         45         MOV         B.H           87         ADD         A         1B         DCX         D         4F         MOV         C.A           80         ADD         B         2B         DCX         H         48         MOV         C.C           81         ADD         C         3B         DCX         SP         49         MOV         C.C           81         ADD         D         F3         DI         4A         MOV         C.C           82         ADD         D         F8         BI         H         4M         MOV         C.C           84         ADD         H         76         HIT.T         4C         MOV         C.L           85         ADD         L         DB         IN         N         4D         MOV         C.L           86         ADD         M         3C         INR         A         4E         MOV         C.M <trr>         60         ADI         N</trr>									
SD         ADC         L         35         DCR         M         45         MOV         B.L           87         ADD         A         1B         DCX         B         46         MOV         B.M           80         ADD         B         2B         DCX         D         4F         MOV         C.A           81         ADD         B         2B         DCX         H         48         MOV         C.C           82         ADD         D         F3         DI         4A         MOV         C.C           82         ADD         D         F3         DI         4A         MOV         C.C           84         ADD         E         FB         EI         4B         MOV         C.C           84         ADD         H         76         HILT         4C         MOV         C.H           85         ADD         L         DB         IN         N         4D         MOV         C.L           86         ADD         M         3C         INR         A         4E         MOV         C.L           87         AMA         A         C         INR									
SE									
87         ADD         A         1B         DCX         D         4F         MOV         CA           80         ADD         B         2B         DCX         H         48         MOV         C,B           81         ADD         C         3B         DCX         SP         49         MOV         C,C           82         ADD         D         F3         DI         4A         MOV         C,D           83         ADD         E         FB         EI         4B         MOV         C,E           84         ADD         H         76         HLT         4C         MOV         C,H           85         ADD         L         DB         IN         N         4D         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         D,A           86         ADD         M         4I         INR         B         57         MOV         D,A           A1         ANA         D         2L									
80         ADD         B         2B         DCX         H         48         MOV         C,B           81         ADD         C         3B         DCX         SP         49         MOV         C,C           82         ADD         D         F3         DI         4A         MOV         C,C           84         ADD         E         FB         EI         4B         MOV         C,E           84         ADD         H         76         HLT         4C         MOV         C,H           85         ADD         L         DB         IN         N         4D         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         C,M           66         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         A         4E         MOV         D,A           A1         ANA         B         14         INR         B         57         MOV         D,C           A1         ANA         B         14									
81         ADD         C         3B         DCX         SP         49         MOV         C,C           82         ADD         D         F3         DI         4A         MOV         C,D           83         ADD         E         FB         EI         4B         MOV         C,E           84         ADD         H         76         HLT         4C         MOV         C,H           85         ADD         L         DB         IN         N         4D         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         D,D           A7         ANA         A         0C         INR         B         57         MOV         D,A           A1         ANA         A         0C         INR         B         50         MOV         D,D           A1         ANA         A         1G         INR         H         53         MOV         D,L           A3         ANA         E         2C									
82         ADD         D         F3         DI         4A         MOV         C,D           83         ADD         E         FB         EI         4B         MOV         C,D           84         ADD         H         76         HLT         4C         MOV         C,H           85         ADD         L         DB         IN         N         4D         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         C,M           66         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         C         50         MOV         D,D           A0         ANA         B         14         INR         D         51         MOV         D,C           A1         ANA         C         IC         INR         E         52         MOV         D,D           A3         ANA         E         2C         INR         H         53         MOV         D,L           A3         ANA         E         2C									
83         ADD         E         FB         EI         4B         MOV         C.E           84         ADD         H         76         HLT         4C         MOV         C.H           85         ADD         L         DB         IN         N         4D         MOV         C.L           86         ADD         M         3C         INR         A         4E         MOV         C.M           C6         ADI         N         04         INR         B         57         MOV         D.D           A7         ANA         A         OC         INR         C         50         MOV         D.B           A0         ANA         B         14         INR         D         51         MOV         D.C           A1         ANA         C         IC         INR         E         52         MOV         D.D           A2         ANA         D         24         INR         H         53         MOV         D.E           A3         ANA         E         2C         INR         L         54         MOV         D.H           A4         ANA         H						SP			
84         ADD         H         76         HLT         4C         MOV         C,H           85         ADD         L         DB         IN         N         4D         MOV         C,H           86         ADD         M         3C         INR         A         4E         MOV         C,M           C6         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         C         50         MOV         D,A           A1         ANA         A         0C         INR         C         50         MOV         D,D           A1         ANA         C         IC         INR         E         52         MOV         D,D           A1         ANA         D         24         INR         H         53         MOV         D,D           A2         ANA         D         24         INR         H         53         MOV         D,D           A3         ANA         L         03         INX         B         56         MOV         D,L           A4         ANA								MOV	
85         ADD         L         DB         IN         N         4D         MOV         C,L           86         ADD         M         3C         INR         A         4E         MOV         C,L           C6         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         C         50         MOV         D,B           A0         ANA         B         14         INR         D         51         MOV         D,D           A1         ANA         B         14         INR         B         52         MOV         D,D           A2         ANA         D         24         INR         H         53         MOV         D,E           A3         ANA         E         2C         INR         L         54         MOV         D,D           A3         ANA         H         34         INR         M         55         MOV         D,L           A3         ANA         H         34         INR         M         55         MOV         D,L           A5	83	ADD			EI			MOV	C,E
86         ADD         M         3C         INR         A         4E         MOV         C,M           C6         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         C         50         MOV         D,B           A0         ANA         B         14         INR         D         51         MOV         D,C           A1         ANA         B         14         INR         D         51         MOV         D,C           A1         ANA         C         IC         INR         E         52         MOV         D,D           A2         ANA         D         24         INR         H         53         MOV         D,E           A3         ANA         E         2C         INR         L         54         MOV         D,H           A4         ANA         H         34         INR         M         55         MOV         D,L           A5         ANA         L         03         INX         B         56         MOV         D,M           A6	84	ADD	H	76	HLT		4C	MOV	C,H
C6         ADI         N         04         INR         B         57         MOV         D,A           A7         ANA         A         0C         INR         C         50         MOV         D,A           A0         ANA         B         14         INR         D         51         MOV         D,C           A1         ANA         C         IC         INR         E         52         MOV         D,D           A2         ANA         D         24         INR         H         53         MOV         D,D           A3         ANA         E         2C         INR         L         54         MOV         D,H           A4         ANA         H         34         INR         M         55         MOV         D,L           A5         ANA         L         03         INX         B         56         MOV         D,L           A6         ANA         M         13         INX         B         56         MOV         E,A           B6         ANI         N         33         INX         B         56         MOV         E,B           CD	85	ADD	L	DB	IN	N	4D	MOV	C,L
A7 ANA A OC INR C 50 MOV D,B A0 ANA B 14 INR D 51 MOV D,C A1 ANA C 1C INR E 52 MOV D,D A2 ANA D 24 INR H 53 MOV D,E A3 ANA E 2C INR L 54 MOV D,H A4 ANA H 34 INR M 55 MOV D,L A5 ANA L 03 INX B 56 MOV D,M A6 ANA M 13 INX D 5F MOV E,A E6 ANI N 23 INX H 58 MOV E,B CC C NN DA JC NN 5A MOV E,B CC CC NN DA JC NN 5B MOV E,E CC CM NN FA JM NN 5B MOV E,E CF CMA C3 JMP NN 5C MOV E,H BF CMP A C2 JNZ NN 5E MOV E,M B8 CMP B F2 JP NN 67 MOV H,A BB CMP B F2 JP NN 67 MOV H,A BB CMP B F2 JP NN 61 MOV H,C BB CMP B CMP C EA JPE NN 62 MOV H,B BC CMP H 3A LDAX D 65 MOV H,B BC CMP H 3A LDAX B 64 MOV H,B BC CMP M 1A LDAX B 64 MOV H,B BC CMP M 1A LDAX D 65 MOV H,B BC CMP M 1A LDAX D 66 MOV H,B BC CMP M 1A LDAX D 66 MOV H,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP NN 11 LXI D,NN 68 MOV L,B BC CMP NN 11 LXI D,NN 68 MOV L,B BC CMP NN 11 LXI SP,NN 60 MOV L,C CC CZ NN 78 MOV A,B 6C MOV L,L DO DAD B 78 MOV A,C 6D MOV M,B DAD D 78 MOV A,C 6D MOV M,B DAD D 78 MOV A,E 77 MOV M,A DAD DAD B 70 MOV A,L 71 MOV M,C DAD DAD B 70 MOV A,L 71 MOV M,C DAD DAD B 70 MOV A,L 71 MOV M,C DAD DAD B 70 MOV A,L 71 MOV M,C	86	ADD	M	3C	INR	A	4E	MOV	C,M
A7 ANA A OC INR C 50 MOV D,B A0 ANA B 14 INR D 51 MOV D,C A1 ANA C 1C INR E 52 MOV D,D A2 ANA D 24 INR H 53 MOV D,E A3 ANA E 2C INR L 54 MOV D,H A4 ANA H 34 INR M 55 MOV D,L A5 ANA L 03 INX B 56 MOV D,M A6 ANA M 13 INX D 5F MOV E,A E6 ANI N 23 INX H 58 MOV E,B CD CALL NN 33 INX B 58 MOV E,B CC CC NN DA JC NN 5A MOV E,D FC CM NN FA JM NN 5B MOV E,E 2F CMA C3 JMP NN 5C MOV E,H 3F CMC D2 JNC NN 5D MOV E,H 3F CMP A C2 JNZ NN 5E MOV E,M B8 CMP B F2 JP NN 67 MOV H,A BB CMP B F2 JP NN 67 MOV H,A BB CMP C EA JPE NN 60 MOV H,B BB CMP E CA JZ NN 62 MOV H,B BB CMP E CA JZ NN 62 MOV H,B BC CMP M 1A LDAX B 64 MOV H,B BC CMP M 1A LDAX B 64 MOV H,B BC CMP M 1A LDAX B 64 MOV H,B BC CMP M 1A LDAX B 64 MOV H,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX D 66 MOV H,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX B 64 MOV L,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX B 64 MOV L,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX D 65 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP M 1A LDAX D 66 MOV L,B BC CMP N 11 LXI D,NN 68 MOV L,B BC CMP N 11 LXI D,NN 68 MOV L,B BC CMP N 11 LXI SP,NN 67 MOV L,C BC CC CZ NN 78 MOV A,B 6C MOV L,L D4 CNC NN 78 MOV A,B 6C MOV L,L D9 DAD B 78 MOV A,C 6D MOV L,L D9 DAD B 78 MOV A,E 77 MOV M,A D9 DAD B 79 MOV A,L D1 MOV M,C D2 MOV M,D E5 PUSH H 9D SBB L	C6	ADI	N	04	INR	В	57	MOV	D,A
A1	A7	ANA	A	0C	INR	C	50	MOV	D,B
A1	A0	ANA	В	14	INR	D	51	MOV	D,C
A2         ANA         D         24         INR         H         53         MOV         D,E           A3         ANA         E         2C         INR         L         54         MOV         D,H           A4         ANA         H         34         INR         M         55         MOV         D,L           A5         ANA         L         03         INX         B         56         MOV         D,M           A6         ANA         M         13         INX         D         5F         MOV         E,A           E6         ANI         N         23         INX         H         58         MOV         E,B           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         58         MOV         E,E           CD         CALL         NN         JB         MOV         E,L         B         MOV         E,L           BF         CMA         C3         JMP         NN         5D         MOV         E,L           BF         CMA </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
A3         ANA         E         2C         INR         L         54         MOV         D,H           A4         ANA         H         34         INR         M         55         MOV         D,L           A5         ANA         L         03         INX         B         56         MOV         D,M           A6         ANA         M         13         INX         D         5F         MOV         E,A           E6         ANI         N         23         INX         H         58         MOV         E,B           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,B           CD         CC         NN         DA         JC         NN         5A         MOV         E,E           CC         CM         NN         DA         JC         NN         5B         MOV         E,E           2F         CMA         C3         JMP         NN         5D         MOV         E,L           BF         CMP									
A4         ANA         H         34         INR         M         55         MOV         D,L           A5         ANA         L         03         INX         B         56         MOV         D,M           A6         ANA         M         13         INX         D         5F         MOV         E,A           E6         ANI         N         23         INX         H         58         MOV         E,B           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,E           DC         CC         NN         DA         JC         NN         5A         MOV         E,E           EC         CM         NN         FA         JM         NN         5B         MOV         E,E           EF         CMA         C3         JMP         NN         5D         MOV         E,L           BF         CMC         D2         JNC         NN         5D         MOV         E,L           BF         CMC         D2 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
A5         ANA         L         03         INX         B         56         MOV         D,M           A6         ANA         M         13         INX         D         5F         MOV         E,A           E6         ANI         N         23         INX         H         58         MOV         E,A           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,C           DC         CC         NN         DA         JC         NN         5B         MOV         E,E           2F         CMA         C3         JMP         NN         5C         MOV         E,B           3F         CMC         D2         JNC         NN         5D         MOV         E,L           BF         CMP         A         C2         JNZ         NN         67         MOV         H,A           B8         CMP         B <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
A6         ANA         M         13         INX         D         5F         MOV         E,A           E6         ANI         N         23         INX         H         58         MOV         E,B           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         DA         JC         NN         5B         MOV         E,D           FC         CMA         NN         FA         JM         NN         5B         MOV         E,D           FC         CMA         NN         FA         JM         NN         5D         MOV         E,D           BF         CMA         C3         JMP         NN         5D         MOV         E,B           BF         CMP         A         C2         JNZ         NN         60         MOV         H,A           B8         CMP </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
E6         ANI         N         23         INX         H         58         MOV         E,B           CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,D           FC         CN         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         DA         JC         NN         5B         MOV         E,D           FC         CM         NN         FA         JM         NN         5B         MOV         E,E           2F         CMA         C3         JMP         NN         5D         MOV         E,E           3F         CMC         D2         JNC         NN         5D         MOV         E,B           3F         CMC         D2         JNC         NN         5D         MOV         E,B           BF         CMP         A         C2         JNZ         NN         67         MOV         H,A           BB         CMP         A         C2<									
CD         CALL         NN         33         INX         SP         59         MOV         E,C           DC         CC         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         DA         JC         NN         5B         MOV         E,E           2F         CMA         CM         NN         FA         JM         NN         5B         MOV         E,E           2F         CMA         CMA         C3         JMP         NN         5D         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           BF         CMP         A         C2         JNZ         NN         61         MOV         H,A           BB         CMP <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									
DC         CC         NN         DA         JC         NN         5A         MOV         E,D           FC         CM         NN         FA         JM         NN         5B         MOV         E,E           2F         CMA         C3         JMP         NN         5C         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,L           BF         CMP         A         C2         JNZ         NN         5E         MOV         E,M           B8         CMP         B         F2         JP         NN         60         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,B           BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         D         E2         JPO         NN         63         MOV         H,D           BC         CMP         H         3A<									
FC         CM         NN         FA         JM         NN         5B         MOV         E,E           2F         CMA         C3         JMP         NN         5C         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,H           BF         CMP         A         C2         JNZ         NN         5D         MOV         E,L           BB         CMP         A         C2         JNZ         NN         5E         MOV         E,M           BB         CMP         B         F2         JP         NN         60         MOV         H,A           BB         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         63         MOV         H,D           BC         CMP         L         0A<									
2F         CMA         C3         JMP         NN         5C         MOV         E,H           3F         CMC         D2         JNC         NN         5D         MOV         E,L           BF         CMP         A         C2         JNZ         NN         5E         MOV         E,L           BF         CMP         A         C2         JNZ         NN         5E         MOV         E,M           BB         CMP         B         F2         JP         NN         67         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,A           B9         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BC         CMP         M<									
3F         CMC         D2         JNC         NN         5D         MOV         E,L           BF         CMP         A         C2         JNZ         NN         5E         MOV         E,M           B8         CMP         B         F2         JP         NN         67         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,B           BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         H         3A         LDAX         B         64         MOV         H,H           BC         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC<			1414						
BF         CMP         A         C2         JNZ         NN         5E         MOV         E,M           B8         CMP         B         F2         JP         NN         67         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,B           BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         01         LXI         B,NN         66         MOV         L,A           F4									
B8         CMP         B         F2         JP         NN         67         MOV         H,A           B9         CMP         C         EA         JPE         NN         60         MOV         H,B           BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         B,NN         6B         MOV         L,C <t< td=""><td></td><td></td><td>٨</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>			٨						
B9         CMP         C         EA         JPE         NN         60         MOV         H,B           BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         H         3A         LDAX         B         64         MOV         H,H           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         21         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         31         LXI         H,NN         69         MOV         L,C           <									
BA         CMP         D         E2         JPO         NN         61         MOV         H,C           BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         31         LXI         SP,NN         6A         MOV         L,D									
BB         CMP         E         CA         JZ         NN         62         MOV         H,D           BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D									
BC         CMP         H         3A         LDA         NN         63         MOV         H,E           BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           D4         CNC         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,L <tr< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr<>									
BD         CMP         L         0A         LDAX         B         64         MOV         H,H           BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           C4         CNZ         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,L           27         DAD         B         7A         MOV         A,E         77         MOV         M,A <tr< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr<>									
BE         CMP         M         1A         LDAX         D         65         MOV         H,L           D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           C4         CNZ         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,M           19         DAD         B         7A         MOV         A,E         77         MOV         M,A           29 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
D4         CNC         NN         2A         LHLD         NN         66         MOV         H,M           C4         CNZ         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,E         77         MOV         M,A           19         DAD         D         7B         MOV         A,H         70         MOV         M,B           39<									
C4         CNZ         NN         01         LXI         B,NN         6F         MOV         L,A           F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,L         71         MOV         M,C           72 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
F4         CP         NN         11         LXI         D,NN         68         MOV         L,B           EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
EC         CPE         NN         21         LXI         H,NN         69         MOV         L,C           FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
FE         CPI         N         31         LXI         SP,NN         6A         MOV         L,D           E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
E4         CPO         NN         7F         MOV         A,A         6B         MOV         L,E           CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
CC         CZ         NN         78         MOV         A,B         6C         MOV         L,H           27         DAA         79         MOV         A,C         6D         MOV         L,L           09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
27       DAA       79       MOV       A,C       6D       MOV       L,L         09       DAD       B       7A       MOV       A,D       6E       MOV       L,M         19       DAD       D       7B       MOV       A,E       77       MOV       M,A         29       DAD       H       7C       MOV       A,H       70       MOV       M,B         39       DAD       SP       7D       MOV       A,L       71       MOV       M,C         72       MOV       M,D       E5       PUSH       H       9D       SBB       L									
09         DAD         B         7A         MOV         A,D         6E         MOV         L,M           19         DAD         D         7B         MOV         A,E         77         MOV         M,A           29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L			NN						
19       DAD       D       7B       MOV       A,E       77       MOV       M,A         29       DAD       H       7C       MOV       A,H       70       MOV       M,B         39       DAD       SP       7D       MOV       A,L       71       MOV       M,C         72       MOV       M,D       E5       PUSH       H       9D       SBB       L									
29         DAD         H         7C         MOV         A,H         70         MOV         M,B           39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
39         DAD         SP         7D         MOV         A,L         71         MOV         M,C           72         MOV         M,D         E5         PUSH         H         9D         SBB         L									
72 MOV M,D E5 PUSH H 9D SBB L								MOV	M,B
72 MOV M,D E5 PUSH H 9D SBB L	39	DAD	SP	7D	MOV	A,L	71	MOV	M,C
	72	MOV	M,D	E5	PUSH		9D	SBB	L
i l	1	MOV	ΜE	F5	PUSH	PSW	9E	SBB	M

74	MOV	M,H	17	RAL		DE	SBI	N
75	MOV	M,L	1F	RAR		22	SHLD	NN
3E	MVI	A,N	D8	RC		30	SIM	
06	MVI	B,N	C9	RET		F9	SPHL	
0E	MVI	C,N	20	RIM		32	STA	NN
16	MVI	D,N	07	RLC		02	STAX	В
1E	MVI	E,N	F8	RM		12	STAX	D
26	MVI	H,NN	D0	RNC		37	STC	
2E	MVI	L,N	C0	RNZ		97	SUB	A
36	MVI	M,N	F0	RP		90	SUB	В
00	NOP		E8	RPE		91	SUB	C
B7	ORA	A	E0	RPO		92	SUB	D
B0	ORA	В	0F	RRC		93	SUB	Е
B1	ORA	C	C7	RST	0	94	SUB	Н
B2	ORA	D	CF	RST	1	95	SUB	L
В3	ORA	E	D7	RST	2	96	SUB	M
B4	ORA	Н	DF	RST	3	D6	SUI	N
B5	ORA	L	E7	RST	4	EB	XCHG	
B6	ORA	M	EF	RST	5	AF	XRA	A
F6	ORI	N	F7	RST	6	A8	XRA	В
D3	OUT	N	FF	RST	7	A9	XRA	C
E9	PCHL		C8	RZ		AA	XRA	D
C1	POP	В	9F	SBB	A	AB	XRA	E
D1	POP	D	98	SBB	В	AC	XRA	Н
E1	POP	Н	99	SBB	C	AD	XRA	L
F1	POP	PSW	9A	SBB	D	AE	XRA	M
C5	PUSH	В	9B	SBB	E	EE	XRA	N
D5	PUSH	D	9C	SBB	Н	E3	XTHL	