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Instructor's Manual
to accompany

**The 8051 Microcontroller
and Embedded System**
Using Assembly and C

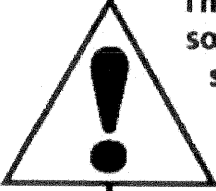
Second Edition

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CHAPTER 0: INTRODUCTION TO COMPUTING

Section 0.1: Numbering and Coding Systems

1.
 - (a) $12_{10} = 1100_2$
 - (b) $123_{10} = 0111\ 1011_2$
 - (c) $63_{10} = 0011\ 1111_2$
 - (d) $128_{10} = 1000\ 0000_2$
 - (e) $1000_{10} = 0011\ 1110\ 1000_2$
2.
 - (a) $100100_2 = 36_{10}$
 - (b) $1000001_2 = 65_{10}$
 - (c) $11101_2 = 29_{10}$
 - (d) $1010_2 = 10_{10}$
 - (e) $00100010_2 = 34_{10}$
3.
 - (a) $100100_2 = 24_{16}$
 - (b) $1000001_2 = 41_{16}$
 - (c) $11101_2 = 1D_{16}$
 - (d) $1010_2 = 0A_{16}$
 - (e) $00100010_2 = 22_{16}$
4.
 - (a) $2B9_{16} = 0011\ 1011\ 1001_2, 697_{10}$
 - (b) $F44_{16} = 1111\ 0100\ 0100_2, 3908_{10}$
 - (c) $912_{16} = 1001\ 0001\ 0010_2, 2322_{10}$
 - (d) $2B_{16} = 0010\ 1011_2, 43_{10}$
 - (e) $FFFF_{16} = 1111\ 1111\ 1111\ 1111_2, 65535_{10}$
5.
 - (a) $12_{10} = 0C_{16}$
 - (b) $123_{10} = 7B_{16}$
 - (c) $63_{10} = 3F_{16}$
 - (d) $128_{10} = 80_{16}$
 - (e) $1000_{10} = 3E8_{16}$
6.
 - (a) $1001010 = 0011\ 0110$
 - (b) $111001 = 0000\ 0111$
 - (c) $10000010 = 0111\ 1110$
 - (d) $111110001 = 0000\ 1111$
7.
 - (a) $2C+3F = 6B$
 - (b) $F34+5D6 = 150A$
 - (c) $20000+12FF = 212FF$
 - (d) $FFFF+2222 = 12221$

8. (a) $24F-129 = 126_{16}$
 (b) $FE9-5CC = A1D_{16}$
 (c) $2FFFF-FFFF = 30000_{16}$
 (d) $9FF25-4DD99 = 5218C_{16}$
9. (a) Hex: 30, 31, 32, 33, 34, 35, 36, 37, 38, 39
 (b) Binary: 11 0000, 11 0001, 11 0010, 11 0011, 11 0100, 11 0101, 11 0110, 11 0111, 11 1000, 11 1001.

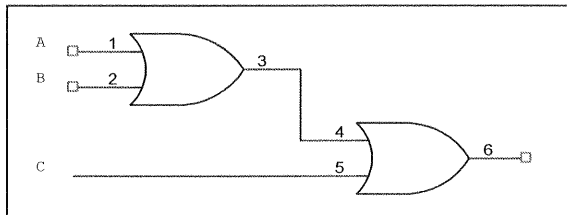
	ASCII (hex)	Binary
0	30	011 0000
1	31	011 0001
2	32	011 0010
3	33	011 0011
4	34	011 0100
5	35	011 0101
6	36	011 0110
7	37	011 0111
8	38	011 1000
9	39	011 1001

10. 000000 22 55 2E 53 2E 41 2E 20 69 73 20 61 20 63 6F 75
 000010 6E 74 72 79 22 0D 0A 22 69 6E 20 4E 6F 72 74 68
 000020 20 41 6D 65 72 69 63 61 22 0D 0A

"U.S.A. is a country".."in North America"..

Section 0.2: Digital Primer

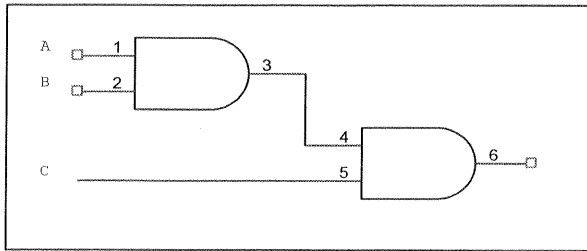
11.



12.

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

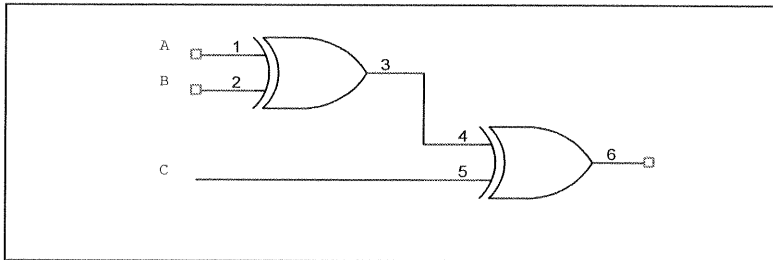
13.



14.

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

15.



A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

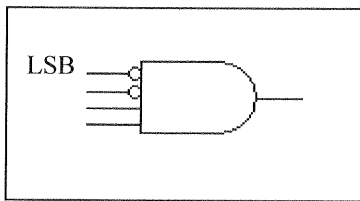
16.

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

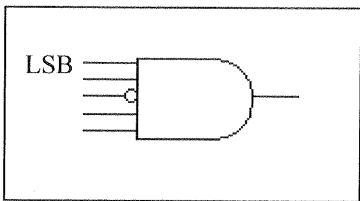
17.

A	B	C	Y
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

18.



19.



20.

CLK	D	Q
No	X	NC
Yes	0	0
Yes	1	1

Section 0.3: Inside the Computer

21. (a) 4
(b) 4
(c) 4
(d) 1 048 576, 2^{20}
(e) 1024K
(f) 1 073 741 824, 2^{30}
(g) 1 048 576 K
(h) 1024M
(i) 8388608, 8192K

22. 1 million pages
23. (a) 589824 bytes
(b) 576 kbytes
24. $2^{32} - 1 = 4294967295$
25. (a) FFh, 255
(b) FFFFh, 65535
(c) FFFF FFFFh, 4 294 967 295
(d) FFFF FFFF FFFF FFFFh, 18 446 744 073 709 551 615
26. (a) 64K
(b) 16M
(c) 4096 Mega, 4G
(d) 256 Tera, 262144 Giga, 268435456 Mega
27. Data bus is bidirectional, address is unidirectional.
28. PC (Program Counter)
29. ALU
30. Address, control and data

CHAPTER 1: THE 8051 MICROCONTROLLERS

Section 1.1: Microcontrollers and Embedded Processors

1. False: A general-purpose microprocessor does not have on-chip ROM.
2. True: A microcontroller has on-chip ROM.
3. True: A microcontroller has on-chip I/O ports.
4. True: A microcontroller has a fixed amount of RAM on the chip.
5. CPU, RAM, ROM, I/O, Timer, Serial COM port
6. RAM and ROM
7. Keyboard, mouse, printer
8. Computing power and compatibility with millions and millions of PCs
9. 8051 - Intel, 6811 – Freescale (Motorola), Z8 – Zilog, PIC 16x – Microchip Technology
10. 8051
11. Power consumption
12. The ROM area is where the executable code is stored
13. Very, in case there is a shortage by one supplier
14. Suppliers other than the manufacturer of the chip
15. Only A is true, 8 bit software will run on a 16 bit system

Section 1.1: Overview of the 8051 Family

16. 4096 bytes
17. 128 bytes
18. 2 timers
19. 256 bytes
20. 8031
21. 32 pins
22. 1 serial port
23. UV-EEPROM
24. EEPROM
25. NV-RAM
26. Flash
27. (a) 4K ROM, 128 Bytes of RAM
(b) 16K ROM, 256 Bytes RAM
(c) 32K ROM, 256 Bytes RAM
28. The OTP version of the 8051
29. The 8031 does not have on-chip ROM.
30. DS89C420/430 are the best for home development, because you can program it serially using IBM PC.