Digital Electronics, Chapters 1 & 2

1. For the pulse shown in Figure 1, graphically determine the following:

(a) rise time **(b)** fall time **(c)** pulse width **(d)** amplitude

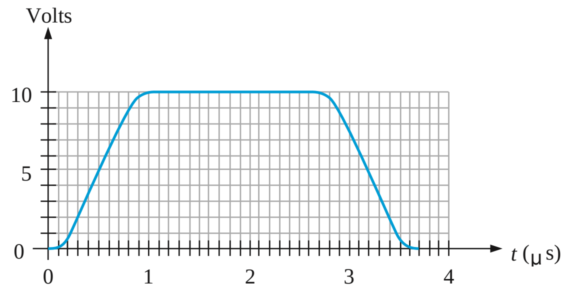

Figure 1

2. A pulse waveform with a frequency of 20 kHz is applied to the input of a counter. During 40 ms, how many pulses are counted?

3. Consider a register that can store eight bits. Assume that it has been reset so that it contains zeros in all positions. If you transfer four alternating bits (0101) serially into the register, beginning with a 1 and shifting to the right, what will the total content of the register be as soon as the fourth bit is stored?

4. Label the pin numbers on the packages in Figure 2. Top views are shown.

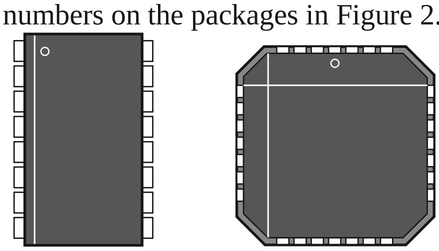

Figure 2

Binary Numbers

5. Convert the following binary numbers to decimal:

(a) 001 **(b)** 010 **(c)** 101 **(d)** 110
(e) 1010 **(f)** 1011 **(g)** 1110 **(h)** 1111

6. Convert the following binary numbers into decimal:

(a) 100001 **(b)** 100111 **(c)** 101010 **(d)** 111001
(e) 1100000 **(f)** 11111101 **(g)** 11110010 **(h)** 11111111

7. Convert each binary number to decimal:

(a) 110011.11 **(b)** 101010.01 **(c)** 1000001.111
(d) 1111000.101 **(e)** 1011100.10101 **(f)** 1110001.0001
(g) 1011010.1010 **(h)** 1111111.11111

8. What is the highest decimal number that can be represented by each of the following numbers of binary digits (bits)?

(a) two **(b)** three **(c)** four **(d)** five **(e)** six **(f)** seven **(g)** eight
(h) nine **(i)** ten **(j)** eleven

9. How many bits are required to represent the following decimal numbers?

(a) 5 **(b)** 10 **(c)** 15 **(d)** 20 **(e)** 100 **(f)** 120 **(g)** 140 **(h)** 160

10. Generate the binary sequence for each decimal sequence:
(a) 0 through 7 **(b)** 8 through 15 **(c)** 16 through 31
(d) 32 through 63 **(e)** 64 through 75

Decimal-to-Binary Conversion

11. Convert each decimal number to binary by using the sum-of-weights method:
(a) 12 **(b)** 15 **(c)** 25 **(d)** 50 **(e)** 65 **(f)** 97 **(g)** 127 **(h)** 198

12. Convert each decimal fraction to binary using the sum-of-weights method:
(a) 0.26 **(b)** 0.762 **(c)** 0.0975

13. Convert each decimal number to binary using repeated division by 2:
(a) 13 **(b)** 17 **(c)** 23 **(d)** 30 **(e)** 35 **(f)** 40 **(g)** 49 **(h)** 60

14. Convert each decimal fraction to binary using repeated multiplication by 2:
(a) 0.76 **(b)** 0.456 **(c)** 0.8732

Binary Arithmetic

15. Add the binary numbers:
(a) 10 + 10 **(b)** 10 + 11 **(c)** 100 + 11 **(d)** 111 + 101 **(e)** 1111 + 111 **(f)** 1111 + 1111

16. Use direct subtraction on the following binary numbers:
(a) 10 - 1 **(b)** 100 - 11 **(c)** 110 – 100
(d) 1111 - 11 **(e)** 1101 - 101 **(f)** 110000 - 1111

17. Perform the following binary multiplications:
(a) 11 * 10 **(b)** 101 * 11 **(c)** 111 * 110
(d) 1100 * 101 **(e)** 1110 * 1110 **(f)** 1111 * 1100

18. Divide the binary numbers as indicated:
(a) 110 / 11 **(b)** 1010 / 10 **(c)** 1111 / 101

Complements of Binary Numbers

19. What are two ways of representing zero in 1’s complement form?

20. How is zero represented in 2’s complement form?

21. Determine the 1’s complement of each binary number:
(a) 100 **(b)** 111 **(c)** 1100 **(d)** 10111011 **(e)** 1001010 **(f)** 10101010

22. Determine the 2’s complement of each binary number using either method:
(a) 11 **(b)** 110 **(c)** 1010 **(d)** 1001 **(e)** 101010 **(f)** 11001 **(g)** 11001100 **(h)** 11000111

Signed Numbers

23. Express each decimal number in binary as an 8-bit sign-magnitude number:
(a) +29 **(b)** 285 **(c)** +100 **(d)** 2123

24. Express each decimal number as an 8-bit number in the 1's complement form:

(a) 234 **(b)** +57 **(c)** 299 **(d)** +115

25. Express each decimal number as an 8-bit number in the 2's complement form:

(a) +12 **(b)** 268 **(c)** +101 **(d)** 2125

26. Determine the decimal value of each signed binary number in the sign-magnitude form:

(a) 10011001 **(b)** 01110100 **(c)** 10111111

27. Determine the decimal value of each signed binary number in the 1's complement form:

(a) 10011001 **(b)** 01110100 **(c)** 10111111

28. Determine the decimal value of each signed binary number in the 2's complement form:

(a) 10011001 **(b)** 01110100 **(c)** 10111111

29. Express each of the following sign-magnitude binary numbers in single-precision floating point format:

(a) 0111110000101011 **(b)** 100110000011000

30. Determine the values of the following single-precision floating-point numbers:

(a) 1 10000001 01001001110001000000000
(b) 0 11001100 10000111110100100000000

Arithmetic Operations with Signed Numbers

31. Convert each pair of decimal numbers to binary and add using the 2's complement form:

(a) 33 and 15 **(b)** 56 and 227 **(c)** 246 and 25 **(d)** 2110 and 284

32. Perform each addition in the 2's complement form:

(a) 10001100 + 00111001 **(b)** 11011001 + 1100111

33. Perform each subtraction in the 2's complement form:

(a) 00110011 - 00010000 **(b)** 01100101 - 1101000

34. Multiply 01101010 by 11110001 in the 2's complement form.

35. Divide 10001000 by 00100010 in the 2's complement form.

Hexadecimal Numbers

36. Convert each hexadecimal number to binary:

(a) 46_{16} **(b)** 54_{16} **(c)** $B4_{16}$ **(e)** FA_{16} **(d)** $1A3_{16}$ **(f)** ABC_{16}

37. Convert each binary number to hexadecimal:

(a) 1111 **(b)** 1011 **(c)** 11111
(d) 10101010 **(e)** 10101100 **(f)** 10111011

38.Convert each hexadecimal number to decimal:

(a) 42_{16} **(b)** 64_{16} **(c)** $2B_{16}$ **(d)** $4D_{16}$

(e) FF_{16} **(f)** BC_{16} **(g)** $6F1_{16}$ **(h)** ABC_{16}

39. Convert each decimal number to hexadecimal:

(a) 10 **(b)** 15 **(c)** 32 **(d)** 54
(e) 365 **(f)** 3652 **(g)** 7825 **(h)** 8925

40. Perform the following additions:

(a) $25_{16} + 33_{16}$ **(b)** $43_{16} + 62_{16}$ **(c)** $A4_{16} + F5_{16}$ **(d)** $FC_{16} + AE_{16}$

41. Perform the following subtractions:

(a) $60_{16} - 39_{16}$ **(b)** $A5_{16} - 98_{16}$ **(c)** $F1_{16} - A6_{16}$ **(d)** $AC_{16} - 10_{16}$

Octal Numbers

42. Convert each octal number to decimal:

(a) 14_8 **(b)** 53_8 **(c)** 67_8 **(d)** 174_8

43. Convert each decimal number to octal by repeated division by 8:

(e) 124 **(f)** 156 **(g)** 654

44. Convert each binary number to octal:

(a) 100 **(b)** 110
(d) 1111 **(e)** 11001
(g) 110011 **(h)** 101010

Binary Coded Decimal (BCD)

45.Convert each of the following decimal numbers to 8421 BCD:

(a) 10 **(b)** 13 **(c)** 18 **(d)** 21 **(e)** 25 **(f)** 36

46.Convert the following decimal numbers to BCD:

(b) 104 **(b)** 128 **(c)** 132 **(d)** 150 **(e)** 186

47. Convert each of the BCD numbers to decimal:

(a) 0001 **(b)** 00011000 **(c)** 100001110000

48. Convert each of the BCD numbers to decimal:

(a) 10000000 **(b)** 001000110111 **(c)** 001101000110 **(d)** 010000100001

51. Add the following BCD numbers:

(b) 0010 + 0001 **(b)** 0101 + 0011

52. Add the following BCD numbers:

a. 1000 + 0110 **(b)** 0111 + 0101 (c) 01010001 + 01011000

Gates

53. The input waveforms applied to a 4-input AND gate are as indicated in Figure 3. The output of the AND gate is fed to an inverter. Draw the net output waveform of this system.

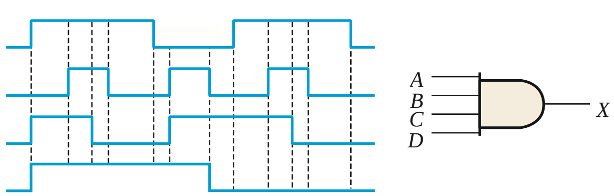

Fig.3

54. For the set of input waveforms in Figure 4, determine the output for the gate shown and draw the timing diagram.

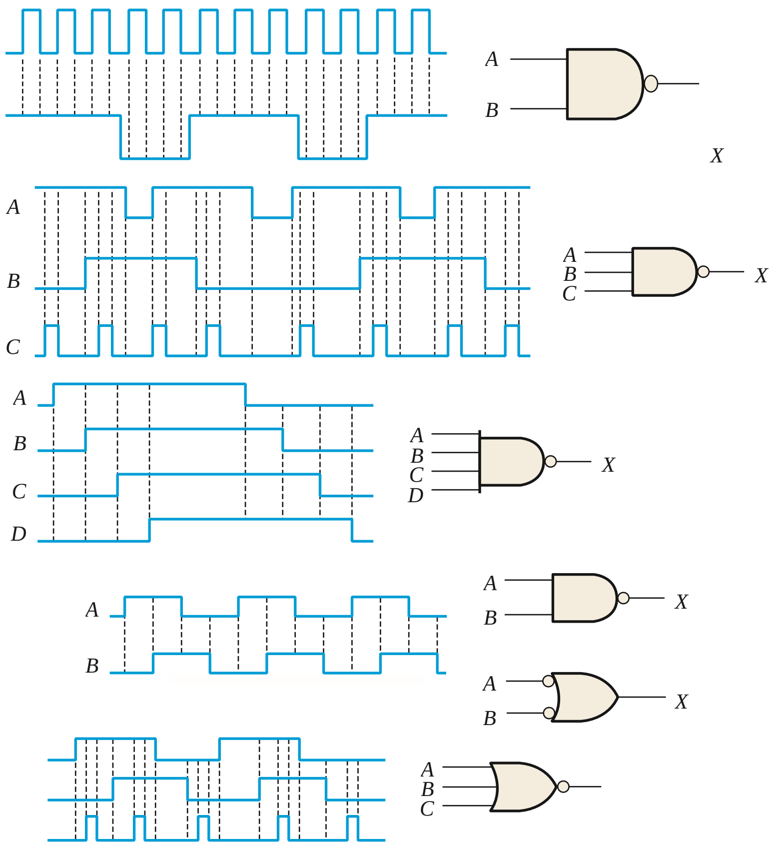

Figure 4

55. Repeat Problem 54 for a OR gates.

56. Determine t_{PLH} and t_{PHL} from the oscilloscope display in Figure 5. The readings indicate volts/div and sec/div for each channel.

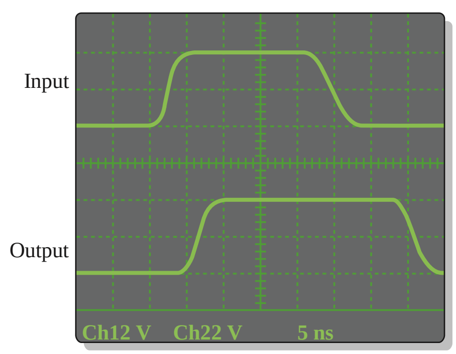

Figure 5

57. Examine the conditions indicated in Figure 6, and identify the faulty gates.

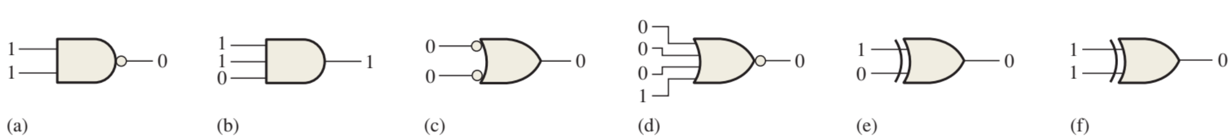

Figure 6

58. Determine the faulty gates in Figure 7 by analyzing the timing diagrams.

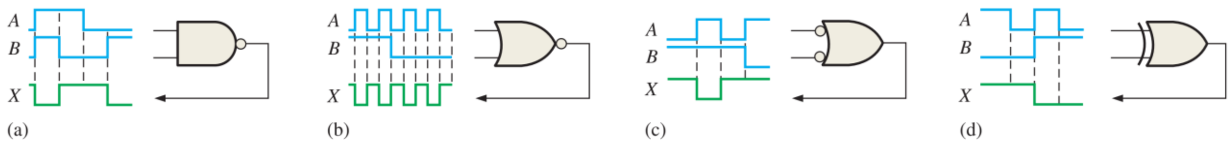

Figure 7

59. Using an oscilloscope, you make the observations indicated in Figure 8. For each observation determine the most likely gate failure.

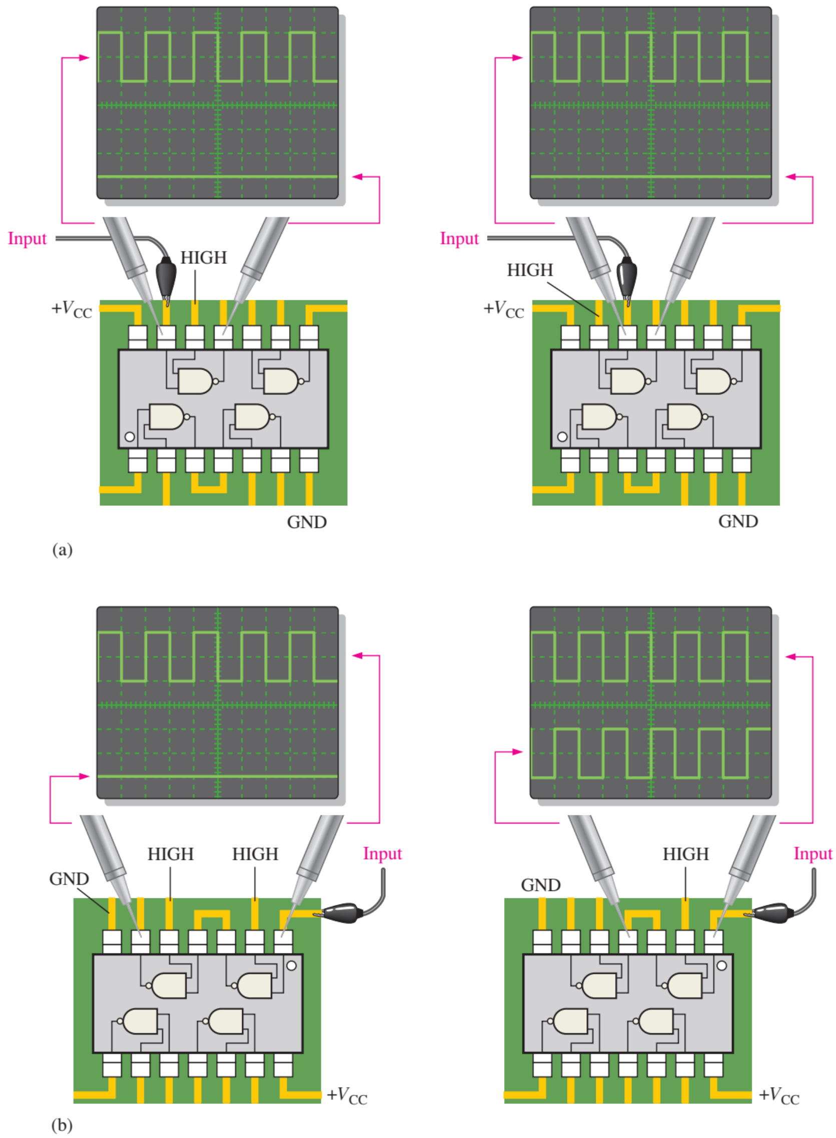

Figure 8