INSTITUTO FEDERAL
DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA
São Paulo

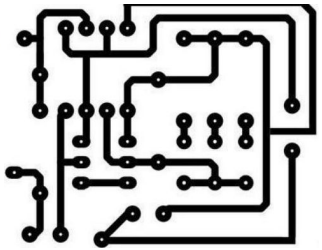
# Sistemas Digitais

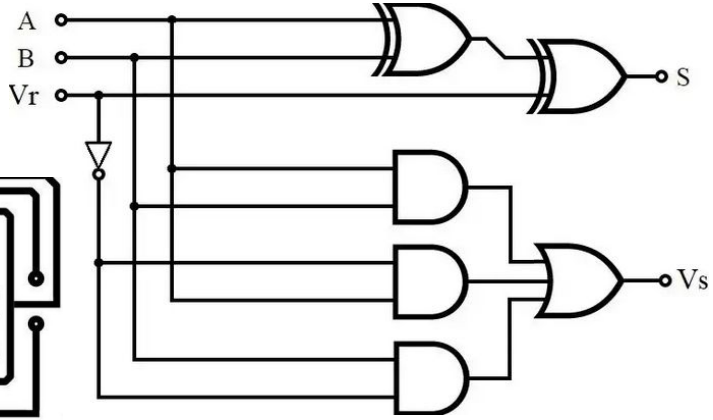
011111101010

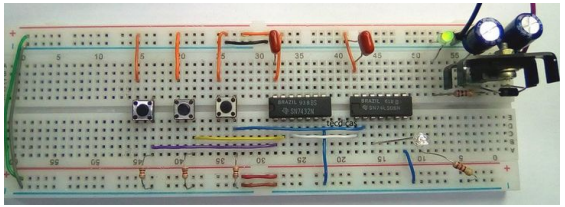
Profº José W. R. Pereira
jose.pereira@ifsp.edu.br
josewrpereira.github.io/docs

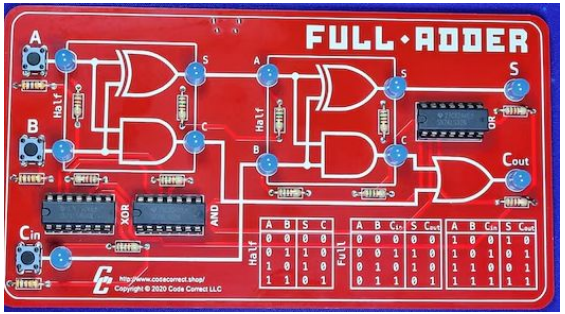
# Definição de Sistemas Digitais

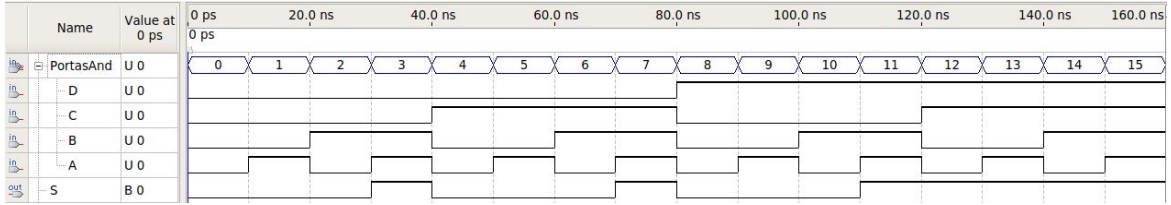
Conjunto de **componentes eletrônicos** **interconectados**, projetado para **processar informações** sob uma forma **discreta**.





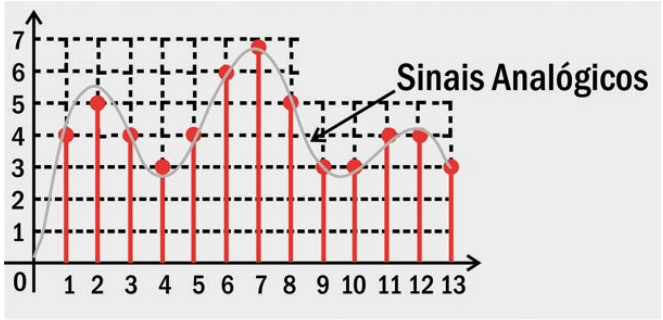



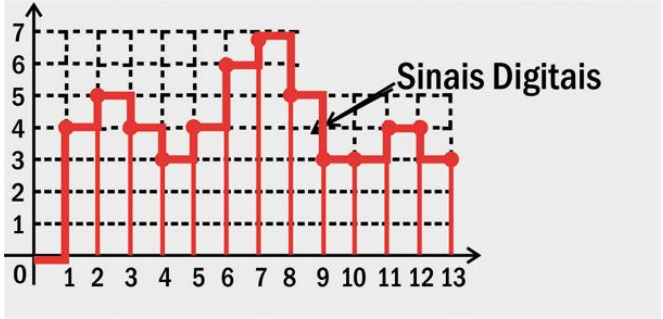


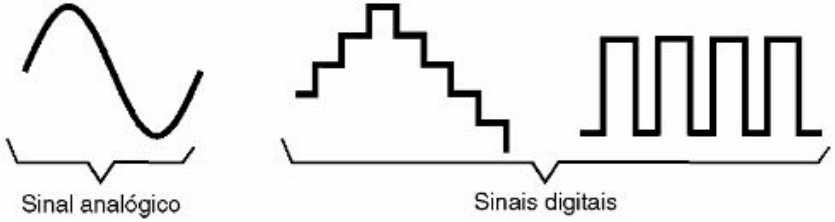



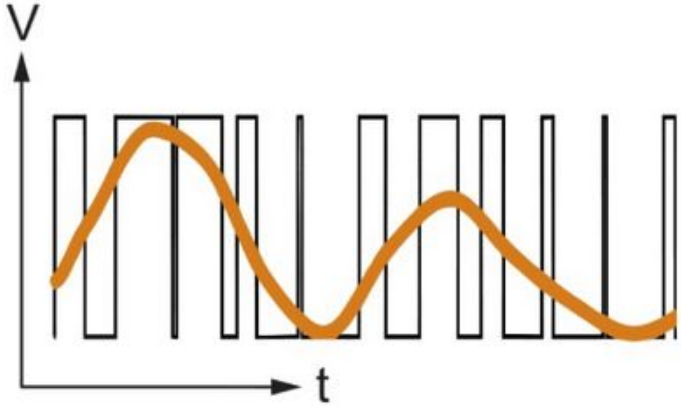
# Sinais analógicos e digitais

Sistemas analógicos: lidam com **funções e sinais contínuos**.
Sistemas digitais: operam através de **pulsos** ou **intervalos predeterminados**, tratando um **conjunto finito de valores**.

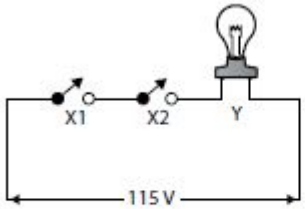


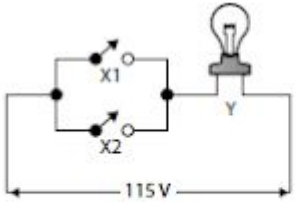



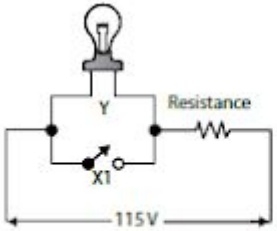



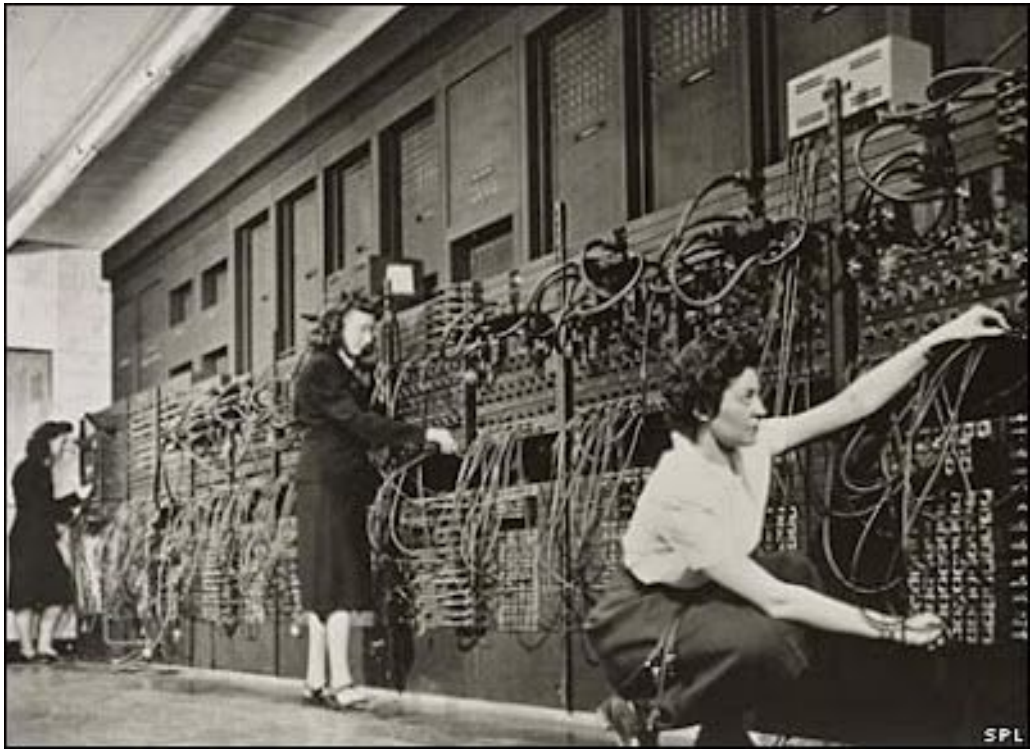



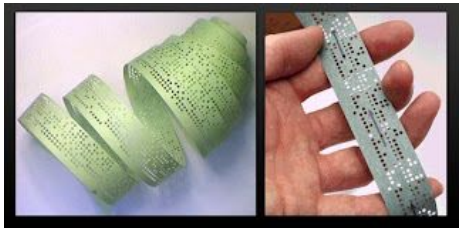
# Sinais discretos no mundo físico

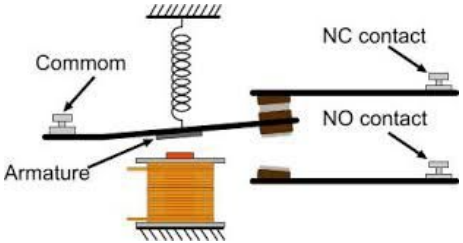


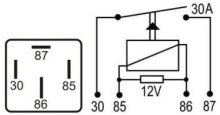



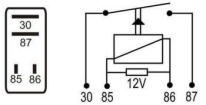





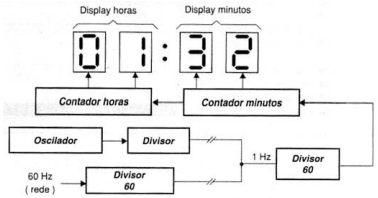


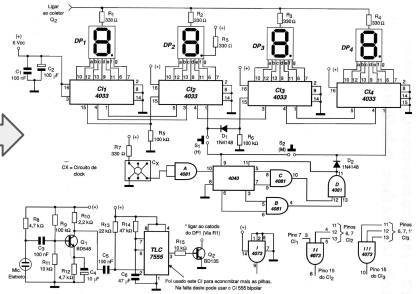


# Hierarquia do sistema digital

- Superior
  - Equipamento / Produto

- Intermediária
  - Descrição estrutural
    - Subsistemas
    - Blocos
    - Funções



- Inferior
  - Descrição funcional
    - Implícita: Função lógica
    - Explícita: Tabela de Entradas e Saída(s)

**X = A.B**

| A | B | X |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

# Hierarquia do sistema digital

- Superior
  - Projetos

---

- Intermediária
  - Circuitos combinacionais
    - Expressões lógicas e circuitos eletrônicos
    - Otimização
    - Boole, De Morgan e Karnaugh
    - Somador, Comparador, Decodificador, Multiplexador
  - Circuitos sequenciais
    - Armazenamento
    - Contagem
    - Latch, Flip-flop, Clock
    - Registrador de deslocamento
    - Contadores

---

- Inferior
  - Sistemas de numeração
    - Bases numéricas (Dec, Bin, Oct, Hex)
    - Códigos (ASCII, BCD, Gray)
  - Elementos lógicos
  - Portas lógicas
    - Tecnologias

# Sistemas de Numeração

# Sistemas de Numeração

Sistemas de numeração são **estruturas matemáticas fundamentais** compostas por um **conjunto de símbolos** e **regras** que permitem a **representação** e a **atribuição de valores numéricos** a grandezas, objetos ou fenômenos do cotidiano.

## Natureza Posicional

Ponto Decimal

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ... | $10^3$ | $10^2$ | $10^1$ | $10^0$ . | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | ... |
| ... | 1000 | 100 | 10 | 1 . | 0,1 | 0,01 | 0,001 | ... |

Ponto Binário

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ... | $2^3$ | $2^2$ | $2^1$ | $2^0$ . | $2^{-1}$ | $2^{-2}$ | $2^{-3}$ | ... |
| ... | 8 | 4 | 2 | 1 . | 0,5 | 0,25 | 0,125 | ... |

# Bases, Conversões e Dígitos Significativos

Valor Posicional = Dígito * Base$^{\text{Posição}}$

Exemplo

$1985 = 1985_{10} = (1985)_{10}$

| | | | | |
|---|---|---|---|---|
| 3 | 2 | 1 | 0 | Posição |
| 10 | 10 | 10 | 10 | Base |
| 1 | 9 | 8 | 5 | Dígito |
| MSD | | | LSD | |
| $1*10^3$ | $9*10^2$ | $8*10^1$ | $5*10^0$ | Valor Posicional |
| 1000 | 900 | 80 | 5 | |

$1000 + 900 + 80 + 5 = 1985_{10}$

Exemplo

$1101_2 = (1101)_2$

| | | | | |
|---|---|---|---|---|
| 3 | 2 | 1 | 0 | Posição |
| 2 | 2 | 2 | 2 | Base |
| 1 | 1 | 0 | 1 | Dígito |
| MSB | | | LSB | |
| $1*2^3$ | $1*2^2$ | $0*2^1$ | $1*2^0$ | Valor Posicional |
| 8 | 4 | 0 | 1 | |

$8 + 4 + 0 + 1 = 13_{10}$

# E agora…

INSTITUTO FEDERAL
DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA
São Paulo

## Sistemas Digitais

011111101010

**Que número é esse?**

Prof. José W. R. Pereira

# Códigos

## ASCII, BCD e Gray

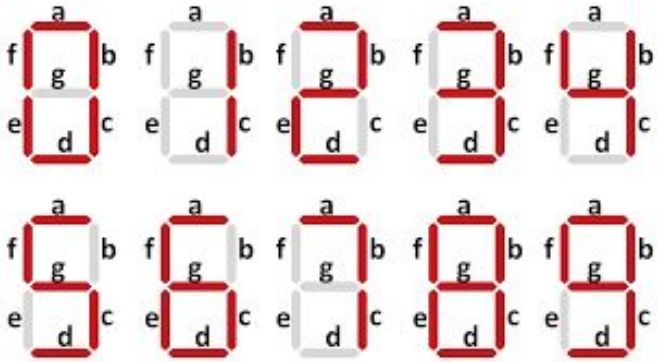
Códigos são **conjuntos de símbolos e regras** utilizados para **representar informações**, sejam elas numéricas, alfanuméricas ou de controle.

# Tabela ASCII

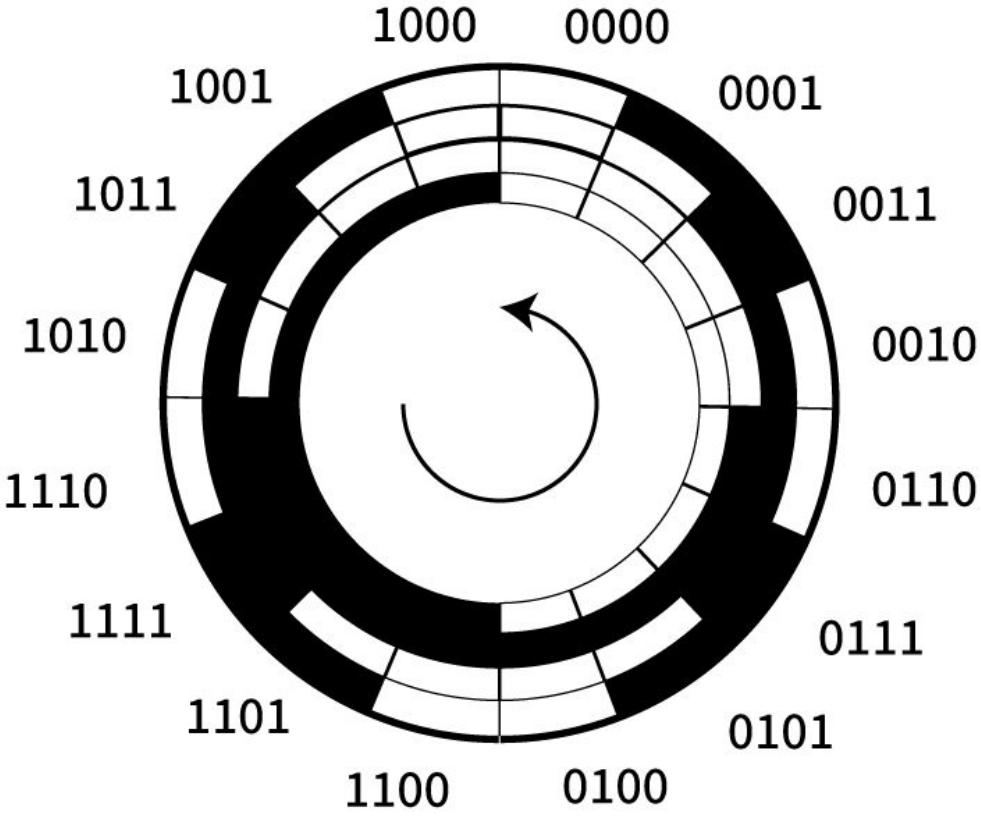
| Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | [NULL] | 32 | 20 | [SPACE] | 64 | 40 | @ | 96 | 60 | ` |
| 1 | 1 | [START OF HEADING] | 33 | 21 | ! | 65 | 41 | A | 97 | 61 | a |
| 2 | 2 | [START OF TEXT] | 34 | 22 | " | 66 | 42 | B | 98 | 62 | b |
| 3 | 3 | [END OF TEXT] | 35 | 23 | # | 67 | 43 | C | 99 | 63 | c |
| 4 | 4 | [END OF TRANSMISSION] | 36 | 24 | $ | 68 | 44 | D | 100 | 64 | d |
| 5 | 5 | [ENQUIRY] | 37 | 25 | % | 69 | 45 | E | 101 | 65 | e |
| 6 | 6 | [ACKNOWLEDGE] | 38 | 26 | & | 70 | 46 | F | 102 | 66 | f |
| 7 | 7 | [BELL] | 39 | 27 | ' | 71 | 47 | G | 103 | 67 | g |
| 8 | 8 | [BACKSPACE] | 40 | 28 | ( | 72 | 48 | H | 104 | 68 | h |
| 9 | 9 | [HORIZONTAL TAB] | 41 | 29 | ) | 73 | 49 | I | 105 | 69 | i |
| 10 | A | [LINE FEED] | 42 | 2A | * | 74 | 4A | J | 106 | 6A | j |
| 11 | B | [VERTICAL TAB] | 43 | 2B | + | 75 | 4B | K | 107 | 6B | k |
| 12 | C | [FORM FEED] | 44 | 2C | , | 76 | 4C | L | 108 | 6C | l |
| 13 | D | [CARRIAGE RETURN] | 45 | 2D | - | 77 | 4D | M | 109 | 6D | m |
| 14 | E | [SHIFT OUT] | 46 | 2E | . | 78 | 4E | N | 110 | 6E | n |
| 15 | F | [SHIFT IN] | 47 | 2F | / | 79 | 4F | O | 111 | 6F | o |
| 16 | 10 | [DATA LINK ESCAPE] | 48 | 30 | 0 | 80 | 50 | P | 112 | 70 | p |
| 17 | 11 | [DEVICE CONTROL 1] | 49 | 31 | 1 | 81 | 51 | Q | 113 | 71 | q |
| 18 | 12 | [DEVICE CONTROL 2] | 50 | 32 | 2 | 82 | 52 | R | 114 | 72 | r |
| 19 | 13 | [DEVICE CONTROL 3] | 51 | 33 | 3 | 83 | 53 | S | 115 | 73 | s |
| 20 | 14 | [DEVICE CONTROL 4] | 52 | 34 | 4 | 84 | 54 | T | 116 | 74 | t |
| 21 | 15 | [NEGATIVE ACKNOWLEDGE] | 53 | 35 | 5 | 85 | 55 | U | 117 | 75 | u |
| 22 | 16 | [SYNCHRONOUS IDLE] | 54 | 36 | 6 | 86 | 56 | V | 118 | 76 | v |
| 23 | 17 | [ENG OF TRANS. BLOCK] | 55 | 37 | 7 | 87 | 57 | W | 119 | 77 | w |
| 24 | 18 | [CANCEL] | 56 | 38 | 8 | 88 | 58 | X | 120 | 78 | x |
| 25 | 19 | [END OF MEDIUM] | 57 | 39 | 9 | 89 | 59 | Y | 121 | 79 | y |
| 26 | 1A | [SUBSTITUTE] | 58 | 3A | : | 90 | 5A | Z | 122 | 7A | z |
| 27 | 1B | [ESCAPE] | 59 | 3B | ; | 91 | 5B | [ | 123 | 7B | { |
| 28 | 1C | [FILE SEPARATOR] | 60 | 3C | < | 92 | 5C | \ | 124 | 7C | \| |
| 29 | 1D | [GROUP SEPARATOR] | 61 | 3D | = | 93 | 5D | ] | 125 | 7D | } |
| 30 | 1E | [RECORD SEPARATOR] | 62 | 3E | > | 94 | 5E | ^ | 126 | 7E | ~ |
| 31 | 1F | [UNIT SEPARATOR] | 63 | 3F | ? | 95 | 5F | _ | 127 | 7F | [DEL] |

# Código BCD (*Binary Coded Decimal*)

| Decimal | 8 4 2 1 | 2 4 2 1 | 8 4 -2 -1 | XS-3 |
|---|---|---|---|---|
| 0 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 0 0 1 1 |
| 1 | 0 0 0 1 | 0 0 0 1 | 0 1 1 1 | 0 1 0 0 |
| 2 | 0 0 1 0 | 0 0 1 0 | 0 1 1 0 | 0 1 0 1 |
| 3 | 0 0 1 1 | 0 0 1 1 | 0 1 0 1 | 0 1 1 0 |
| 4 | 0 1 0 0 | 0 1 0 0 | 0 1 0 0 | 0 1 1 1 |
| 5 | 0 1 0 1 | 1 0 1 1 | 1 0 1 1 | 1 0 0 0 |
| 6 | 0 1 1 0 | 1 1 0 0 | 1 0 1 0 | 1 0 0 1 |
| 7 | 0 1 1 1 | 1 1 0 1 | 1 0 0 1 | 1 0 1 0 |
| 8 | 1 0 0 0 | 1 1 1 0 | 1 0 0 0 | 1 0 1 1 |
| 9 | 1 0 0 1 | 1 1 1 1 | 1 1 1 1 | 1 1 0 0 |



# Código Gray


1000
0000
1001
0001
1011
0011
1010
0010
1110
0110
1111
0111
1101
0101
1100
0100

# Referências


- GOMES, P. S. **Controle e Automação Industrial III**. Disponível em: <https://controleeautomacaoindustrial3.blogspot.com/2012/>. Acesso em: 19 jan. 2026.
- MARIANA,LUCAS, JUAN. **Primeira Geração - Computadores a válvula e relé**. Disponível em: <https://museuvirtualutfpr.blogspot.com/2011/12/primeira-geracao-computadores-valvula-e.html>. Acesso em: 19 jan. 2026.
- TOCCI, Ronald J.; WIDMER, Neal S. ***Sistemas Digitais: Princípios e Aplicações*.** 8. ed. Pearson, 2015.
- PALANIAPPAN, Ramaswamy**.** ***Digital Systems Design*.** bookboon.com, 2011.
- TRINDADE JUNIOR, Rosumiro; JULIÃO, Jodelson Moreira. ***Circuitos Digitais*.** Manaus: Centro de Educação Tecnológica do Amazonas (CETAM), 2012.

# Sistemas Digitais

Profº José W. R. Pereira
jose.pereira@ifsp.edu.br
josewrpereira.github.io/docs