

## BEL ECE HANDWRITTEN NOTES (FULL SUMMARY)

(Write these headings and points exactly as is in your notebook. Short, crisp, exam-focused.)

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### ✦ 1. Number System & Basics

#### ► Conversions

- Decimal → Binary: divide by 2
- Binary → Decimal: positional weights
- Hex ↔ Binary: 4-bit group
- Octal ↔ Binary: 3-bit group

#### ► Important

- **2's complement = 1's complement + 1**
  - **Gray ↔ Binary conversion** (MSB remains same)
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### ✦ 2. Boolean Algebra

#### ► Laws

- De Morgan's:
  - $(AB)' = A' + B'$
  - $(A + B)' = A'B'$
- Idempotent:  $A + A = A$
- Absorption:  $A + AB = A$

#### ► K-map

- 2-variable, 3-variable, 4-variable
  - Find minterms → circle → simplified SOP/POS
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### ✦ 3. Digital Electronics

#### ► Logic gates

Truth tables of: AND, OR, NOT, NOR, NAND, XOR, XNOR

#### ► Combinational Circuits

- **Half adder:** Sum =  $A \oplus B$ , Carry =  $AB$
- **Full adder:** Sum =  $A \oplus B \oplus C_{in}$ , Cout =  $AB + C_{in}(A \oplus B)$

- MUX: output based on select lines
- Encoder, Decoder, Comparator

### ► Sequential Circuits

#### Flip-Flops:

- SR, JK, D, T
- Characteristic equations
- Truth tables
- Edge triggering

### ► Counters

- Ripple (asynchronous)
- Synchronous
- Mod-N counter
- **Ring counter** (1 hot), **Johnson counter** (twisted ring)

### ► Registers

- SISO, SIPO, PISO, PIPO
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## ✦ 4. Analog Electronics

### ► Diode

- Forward biased → conducts
- Reverse biased → no conduction
- Zener diode → voltage regulation

### ► BJT

- Modes: Cutoff, Active, Saturation
- Acts as amplifier (active) or switch (saturation)

### ► MOSFET

- Types: NMOS, PMOS
- Regions: Cutoff, Triode/Linear, Saturation
- Gate threshold voltage  $V_{th}$

### ► OP-AMP (VERY IMPORTANT)

#### Ideal properties:

- $\infty$  gain,  $\infty$  Rin, 0 Rout

### Configurations:

- Inverting:
    - Gain =  $-R_f/R_{in}$
  - Non-Inverting:
    - Gain =  $1 + R_f/R_1$
  - Voltage follower  $\rightarrow A_v = 1$
  - Integrator  $\rightarrow$  output decreases linearly
  - Differentiator  $\rightarrow$  output proportional to slope of input
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## ✦ 5. Signals & Systems

### ► Signal Types

- Continuous / Discrete
- Even / Odd
- Energy / Power signals

### ► LTI Systems

- Conditions: Linear + Time invariant
- Convolution:  $y(t) = x(t) * h(t)$

### ► Fourier

- Converts time-domain  $\rightarrow$  frequency domain
- Fourier Transform, Fourier Series (concept only)

### ► Sampling

- **Nyquist rate =  $2 \times f_{max}$**
  - Aliasing  $\rightarrow$  due to under-sampling
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## ✦ 6. Communication Systems

### ► Analog Communication

- AM modulation index =  $(A_{max} - A_{min}) / (A_{max} + A_{min})$
- FM: frequency deviation + modulation index
- Bandwidth (FM)  $\sim$  Carson rule:  $2(\Delta f + f_m)$

► **Noise**

- Noise adds randomly
- **SNR = Signal power / Noise power**

► **Digital**

- Bits, Baud rate, Bandwidth basics
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✦ **7. Microprocessors (8085 Basics)**

► **Architecture**

- Registers: A, B, C, D, E, H, L
- Program Counter
- Flag register

► **Addressing Modes**

- Immediate: MVI A, 05
- Register
- Register indirect
- Direct

► **Instruction Types**

- Data transfer
  - Arithmetic
  - Logical
  - Branching
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✦ **8. Control Systems**

► **Basics**

- Open-loop vs Closed-loop
- Advantages of feedback: reduced error, stable operation

► **Transfer Function**

- Ratio of output/input in Laplace domain

► **Stability**

- Only qualitative understanding required for BEL

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## 🌟 9. Power Electronics

### ▶ Devices

- SCR → controlled rectifier
- DIAC → triggers TRIAC
- TRIAC → AC switching

### ▶ Applications

- Motor control
  - Dimmer
  - AC power control
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## 🌟 10. Aptitude (BEL always includes 15–20 questions)

### ▶ Important topics

- Percentages & ratios
  - Time & work
  - Time & distance
  - Profit & loss
  - Averages
  - Probability (basic)
  - Simplification
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## 🌟 11. High-Yield BEL Formulas (Must Memorize)

Topic	Formula
Cutoff freq (RC)	$f_c = \frac{1}{2\pi RC}$
Frequency ↔ Period	$f = 1/T$
SNR	$SNR = \frac{P_s}{P_n}$
Full Adder Sum	$A \oplus B \oplus C_{in}$
Mod-N counter	Counts 0 to N-1

Topic	Formula
Nyquist rate	$\geq 2 \times f_{\max}$
Op-amp inverting gain	$-R_f/R_{in}$
Op-amp non-inverting gain	$1 + (R_f/R_1)$

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### 🌟 12. 2–3 Page Quick Revision at the End

Revise:

- K-maps
- Flip-flops
- Counters
- Op-amp formulas
- Sampling
- AM/FM basics
- Microprocessor basics

These make up **70% of BEL questions.**