# Electronic Devices Important Questions PDF

Electronic Devices usually covers semiconductor physics, carrier transport, the PN junction and special diodes, the bipolar junction transistor, and MOS devices with JFETs. Common questions are carrier concentration using the mass action law, conductivity, Hall effect, built-in potential and depletion width, the diode equation, Early effect and MOSFET threshold voltage and drain current.

## Key takeaways

- Semiconductor physics: energy bands, Fermi level, intrinsic and extrinsic carriers, mass action law.
- Carrier transport: drift, diffusion, Einstein relation, continuity equation and Hall effect.
- PN junction: built-in potential, depletion width, diode equation, capacitances, breakdown and special diodes.
- BJT and MOS devices: transistor action, Early effect, MOS capacitor, MOSFET I-V and JFET equations.
- These are practice questions based on common syllabus topics, not verified past papers.

## About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Electronic Devices, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

## Unit 1: Semiconductor Physics

**Key definitions:** energy band diagram, conduction and valence bands, band gap, direct and indirect semiconductors, intrinsic carrier concentration, Fermi-Dirac distribution, Fermi level, donor and acceptor impurities, mass action law ($np = n_i^2$).

**Numericals (answer outline):**

- Silicon is doped with ND = $10^{16}$ $cm^{-3}$ and ni = 1.5 x $10^{10}$ $cm^{-3}$. Find n and p. Outline: n ≈ ND = $10^{16}$ $cm^{-3}$ and p = $ni^2/n$ = 2.25 x $10^4$ $cm^{-3}$.
- Find the conductivity of a doped sample using σ = q(nμn + pμp), and its resistivity ρ = 1/σ.
- Find the position of the Fermi level relative to the intrinsic level: EF - Ei = kT ln(n/ni).

**Long-answer questions:** Explain the variation of the Fermi level with doping and temperature in n-type and p-type semiconductors with band diagrams.

## Unit 2: Carrier Transport

**Key definitions:** drift current, mobility, diffusion current, diffusion coefficient, Einstein relation, generation and recombination, minority carrier lifetime, diffusion length, continuity equation, Hall effect.

**Derivations:**

- Derive the Einstein relation: D/μ = kT/q, which is about 0.0259 V at 300 K.
- Derive the continuity equation for minority carriers.
- Derive the Hall voltage and the Hall coefficient RH = 1/(nq), and explain how the Hall effect identifies n-type or p-type material.

**Numericals (answer outline):**

- Find the diffusion coefficient of electrons from their mobility using the Einstein relation.
- From Hall voltage, current, magnetic field and sample thickness, find the carrier concentration and mobility.

## Unit 3: PN Junction and Special Diodes

**Key definitions:** step junction, depletion region, built-in potential, depletion width, forward and reverse bias, reverse saturation current, transition and diffusion capacitance, Zener and avalanche breakdown.

**Derivations:**

- Derive the built-in potential: V0 = (kT/q) ln(NA ND / $ni^2$).
- Derive the depletion width and the junction capacitance of an abrupt junction.
- Derive the ideal diode equation: I = I0[e^(V/ηVT) - 1].

**Numericals (answer outline):**

- With NA = ND = $10^{16}$ $cm^{-3}$ and ni = 1.5 x $10^{10}$ $cm^{-3}$ at 300 K, find V0. Outline: V0 = 0.0259 x ln($10^{32}$ / 2.25 x $10^{20}$) ≈ 0.0259 x 26.8 ≈ 0.69 V.
- Find the forward current for a given voltage and saturation current using the diode equation.

**Long-answer questions:** Explain the working of an LED, photodiode, solar cell, tunnel diode and varactor diode. Compare Zener and avalanche breakdown, including their temperature coefficients.

## Unit 4: Bipolar Junction Transistor

**Key definitions:** transistor action, emitter injection efficiency, base transport factor, α and β, active, saturation and cut-off modes, Early effect (base-width modulation), punch-through, Ebers-Moll model.

**Important questions:**

- Explain the current components in an NPN transistor and derive the relation $\beta = \alpha/(1 - \alpha)$.
- Explain the Early effect and its effect on the output characteristics.
- Draw and explain the Ebers-Moll model.
- Draw the input and output characteristics in the CE configuration and mark the regions.

## Unit 5: MOS Capacitor, MOSFET and JFET

**Key definitions:** accumulation, depletion and inversion in a MOS capacitor, flat-band voltage, threshold voltage, enhancement and depletion MOSFETs, channel length modulation, body effect, CMOS, JFET pinch-off.

**Results and numericals (answer outline):**

- MOSFET saturation current: $I_D = (\mu_n C_{ox}/2)(W/L)(V_{GS} - V_T)^2$. Doubling $(V_{GS} - V_T)$ increases $I_D$ four times.
- JFET with $I_{DSS} = 10$ mA and $V_P = -4$ V at $V_{GS} = -2$ V: $I_D = I_{DSS}(1 - V_{GS}/V_P)^2 = 10 \times (0.5)^2 = 2.5$ mA.
- Find the threshold voltage of a MOS structure from given oxide thickness, doping and work-function difference.

**Long-answer questions:** Explain the C-V characteristics of a MOS capacitor. Explain the operation and characteristics of an n-channel enhancement MOSFET. Explain how a CMOS inverter works.

## How to score well in Electronic Devices

- Draw band diagrams for every semiconductor and junction question. They explain the physics faster than words.
- Keep a constants sheet: q, k, kT/q at 300 K, $n_i$ for silicon and the permittivity of silicon and oxide.
- Check units carefully. Most numericals use $cm^{-3}$ and $cm^2/V\text{-}s$, so do not mix cm and m.
- Learn the derivations of $V_0$, depletion width, the diode equation and the Einstein relation fully.

## Short-answer (2-mark) questions for Electronic Devices

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. What is the difference between a direct and an indirect band gap semiconductor?
2. State the mass action law.
3. Define mobility and give its unit.
4. State the Einstein relation.
5. What does the sign of the Hall coefficient tell you?
6. Define diffusion length.

7. Why does depletion width increase with reverse bias?
8. Differentiate between transition and diffusion capacitance.
9. What is the Early effect?
10. Define threshold voltage of a MOSFET.
11. What is channel length modulation?
12. What is pinch-off voltage in a JFET?

## A 7-day revision plan for Electronic Devices

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Semiconductor Physics):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Carrier Transport):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, PN Junction and Special Diodes):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Bipolar Junction Transistor):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, MOS Capacitor, MOSFET and JFET):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

## Frequently asked questions

### Which derivations are most important in Electronic Devices?

Einstein relation, continuity equation, Hall coefficient, built-in potential, depletion width, the ideal diode equation and the MOSFET drain current equation are the core derivations in most syllabi.

### How is Electronic Devices useful for GATE?

Semiconductor physics, PN junctions, BJTs and MOSFETs are part of the GATE ECE syllabus, so the same concepts and numericals help with GATE preparation.

### What constants should I remember?

Electron charge, Boltzmann's constant, kT/q of about 0.0259 V at 300 K, the intrinsic concentration of silicon (often taken as $1.5 \times 10^{10}$ $cm^{-3}$ in textbooks) and the relative permittivity of silicon and silicon dioxide.

### Are these questions from real past papers?

No. These are practice questions based on topics that are common in B.Tech syllabi. They are not verified past papers, and no question is promised to appear in your exam. Check your own

university syllabus and official previous papers; AKTU students can use the AKTU old question paper archive.

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## Sources and further reading

- AKTU: Old question papers (official archive)
- AKTU: Syllabus
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- AICTE: All India Council for Technical Education

## About this PDF

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