📘 EEE Lab Viva Preparation Guide (Source: ChatGPT)

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1. Diode Characteristics (LED, Silicon, Zener)

🔍 Objective:

To plot the I-V characteristics for different diodes: LED, Silicon, and Zener.

- **LED & Silicon: Only forward bias.**
- **Zener Diode: Both forward and reverse bias.**

📌 Summary:

- **Forward bias: Diode conducts after threshold (cut-in) voltage.**
- **Reverse bias: No conduction until Zener breakdown (Zener diode only).**
- **Zener effect: Sharp reverse conduction at breakdown voltage (voltage regulation).**
- **LED: Emits light when forward biased due to photon emission.**

❓ Viva Questions:

Easy:

- **What is the threshold voltage of a silicon diode?**
  → ~0.7V
- **What is the threshold voltage of an LED?**
  → ~1.8V to 3.3V depending on color.
- **What is a Zener diode used for?**
  → Voltage regulation in reverse bias.

Medium:

- **Why doesn't a normal diode conduct in reverse bias?**
  → Depletion region widens and blocks current flow.
- **How is Zener breakdown different from Avalanche breakdown?**
  → Zener: quantum tunneling; Avalanche: carrier multiplication.

Hard:

- **Explain how doping affects breakdown voltage in Zener diodes.**
  → Heavily doped → narrow depletion → low breakdown voltage.
- **Why does an LED emit light but silicon diode doesn't?**
  → LED is made from direct bandgap materials; silicon is indirect.

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2. Half-Wave & Full-Wave Rectifiers

🔍 Objective:

To demonstrate the conversion of AC to DC using diode-based rectifiers.

📌 Summary:

- **Half-Wave Rectifier: Passes one half of AC cycle using a single diode.**
- **Full-Wave Rectifier: Uses both halves (center-tap or bridge).**
- **Output: Pulsating DC (filtered optionally).**
- **Application: Power supplies.**

❓ Viva Questions:

Easy:

- **What is a rectifier?**
  → Circuit that converts AC to DC.
- **What is the purpose of a filter capacitor in rectifiers?**
  → Smoothens ripples in output voltage.

Medium:

- **Why is full-wave rectification preferred over half-wave?**
  → Higher efficiency, smoother output.
- **What is the ripple frequency of a full-wave rectifier?**
  → Twice the input AC frequency.

Hard:

- **Derive the expression of ripple factor for half and full-wave rectifiers.**
- **What is PIV (Peak Inverse Voltage)?**
  → Maximum reverse voltage a diode must withstand.

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3. Transistor DC Analysis (Voltage Divider Bias)

🔍 **Objective:**

To obtain input and output characteristics of a BJT using voltage divider bias.

📌 **Summary:**

- **Voltage Divider Bias: Resistors bias base voltage for stability.**
- **Input Graph: IB vs VBE (base-emitter).**
- **Output Graph: IC vs VCE (collector-emitter).**
- **Establishes Q-point (operating point).**

❓ **Viva Questions:**

Easy:

- **What are the terminals of a BJT?**
  → Base, Collector, Emitter.
- **What is β (beta) of a transistor?**
  → Ratio of collector current to base current (IC/IB).

Medium:

- **Why use voltage divider bias instead of fixed bias?**
  → Better thermal stability.
- **What is the typical VBE for a silicon transistor?**
  → ~0.7V

Hard:

- **Explain how the Q-point can shift due to temperature.**
  → IC increases → VCE decreases → possible saturation.

- **Derive the expression for base bias voltage in voltage divider configuration.**

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4. Transistor AC Analysis (Voltage Divider Bias)

🔍 **Objective:**

To observe amplification behavior of a transistor under AC input.

📌 **Summary:**

- **Uses small signal AC on top of DC bias.**
- **Coupling capacitors block DC, pass AC.**
- **Measures voltage gain (Av) = Vout / Vin.**
- **BJT operates in active region for amplification.**

❓ **Viva Questions:**

Easy:

- **Why do we need coupling capacitors?**
  → To prevent DC bias disturbance between stages.

Medium:

- **What causes phase reversal in transistor amplifiers?**
  → In common-emitter, output is 180° out of phase with input.

Hard:

- **Explain bandwidth and its importance in amplifiers.**
  → Range of frequencies amplifier can handle efficiently.
- **Why does gain drop at high frequencies?**
  → Internal capacitances and parasitic effects.

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5. 2-bit Comparator using LM324

🔍 Objective:

To compare two 2-bit binary numbers and generate logical output signals (A>B, A<B, A=B).

📌 Summary:

- Uses LM324 quad op-amp IC.
- Inputs converted to analog voltages (if necessary).
- Comparators output HIGH or LOW depending on voltage difference.
- Implements basic digital logic using analog components.

❓ Viva Questions:

Easy:

- What is the function of a comparator?
  → Outputs HIGH or LOW based on comparison between two inputs.

Medium:

- Why choose LM324 for comparator circuits?
  → Has 4 op-amps, works on single supply, low cost.

Hard:

- How to convert a 2-bit binary input into analog for comparison?
  → Use weighted resistors or DAC logic.
- Can we use a comparator to build ADC? How?
  → Yes, using multiple comparators (flash ADC architecture).

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6. 3-bit Parallel ADC using LM324 and 74LS148N

🔍 Objective:

To convert an analog voltage into 3-bit digital output using comparators and a priority encoder.

📌 **Summary:**

- **LM324 compares input with reference voltages.**
- **Each comparator gives a HIGH/LOW depending on comparison.**
- **74LS148N encodes which comparator was last HIGH → outputs 3-bit binary code.**
- **Very fast conversion → called Flash ADC.**

❓ **Viva Questions:**

Easy:

- **What does ADC stand for?**
  → Analog to Digital Converter.

Medium:

- **How does a flash ADC work?**
  → Multiple comparators compare input with known references simultaneously.

Hard:

- **Why use 74LS148N?**
  → 8-to-3 line priority encoder simplifies output logic.
- **What is quantization error in ADC?**
  → Error due to representing continuous input as discrete levels.

🔚 **General Viva Tips:**

- **Revise circuit diagrams for each experiment.**
- **Understand input/output behavior clearly.**
- **Practice drawing graphs (diode I-V, transistor input/output).**
- **Be familiar with IC pinouts: LM324, 74LS148N.**
- **Know basic formulae: gain, ripple factor, bias voltages.**
- **Be ready to explain real-life applications of each circuit.**