Electrical Engineering Workshop (ইলেকিট্রিকাল ইঞ্জিনিয়ারিং) 3 hours/day

Week 1: From Electrons to Circuits (ইলেক্ট্রন থেকে সার্কিট)

Lesson 1.3: Fundamentals of Electricity: Diodes, How to Use a Breadboard, and Designing Simple Circuits (ইলেক্ট্রিসিটির মূলসূত্র)

• RECAP: R, L, C in series and parallel; R, L, C behavior with AC and DC o Any questions?? Better ask now because I'll soon be testing your understanding!	• 10 m
• MINI-QUIZ! Erase everything on the board and give them a mini quiz to test understanding from first two classes.	• 10 m

• RECALL: Remember we talked about AC signals?
  o DRAW: Graph of AC signal with voltage going positive and negative.
  o DRAW: Circuit with AC voltage connected to resistor.
  o POSE QUESTION: What does the voltage look like across the resistor? Same as the graph I just drew right? What if I don't want any negative voltage across my resistor? What if I want just positive? (Draw desired output) I need another component right? Can I make that happen with R, L, and C's?
  o GUIDE THROUGH: what happens if we put an R, L, or C between the VAC and the R? Do any of these work? DRAW graphs of voltage across R for each inserted R, L, or C.
  o WORKSHEET: Explain why we might want to only allow current to flow one way. Also students draw graphs as we go through the examples on the board.
	• 10 m

• NEW CONCEPT: None of those components worked, so we need a new component! This component is called a diode. A diode only allows current to flow one way, and it blocks negative voltage. It only allows current in the direction of the arrow.
  o VOCABULARY: The back of the arrow is called the anode. The front of the arrow is called the cathode.
  o DRAW: Trace over graph of input to show what parts the diode will allow to pass and how it blocks negative current.
  o DRAW: Draw over schematic to show direction of current allowed and draw what happens (open circuit) when the voltage turns negative
  o ASK: Can someone come up and draw the voltage across the resistor with the diode in between?
  o CHALLENGE ASK: Can someone come up and draw the voltage across the resistor with the diode in between but in the opposite direction? GUIDE whoever comes up in drawing the graph.
  o WORKSHEET: Drawing graphs of voltage output in diode circuits.
	• 10 m

• RECALL: Remember how we talked about an LED: That stands for Light Emitting Diode. And that's also why the schematic symbol looks almost just like the diode schematic symbol!
  o ASK: Someone remind us, what does an LED do?
  o POSE QUESTION: If we are able to emit light by flowing a current through an LED, do you think that we can create the reverse type of component? Can we have a component that, when we shine light on it, it causes current to flow? What are your thoughts?
	• 10 m

• NEW CONCEPT: So yes, that component does exist and it's called a photodiode!
  o DRAW: Diagram of P-N junction and show that when light hits, the photon's energy separates the electrons and holes, causing a current to flow. We will use a photodiode to make your heartbeat monitor!
  o WORKSHEET: Draw and explain how a photodiode works.	

• NEW CONCEPT: Now, there's one last type of diode I want to teach you about, and it's called a Zener diode.
  o DRAW: In a circuit like this: Draw V, R, Z.
  o EXPLAIN: A Zener diode always ensures that the voltage across its pins is a certain voltage. If it's a 4.7V Zener diode, then the voltage across the Zener diode must be 4.7V, and it will be able to take in very large amounts of currents to ensure this.
  o ASK: Someone come up and use Ohm's Law to calculate the current that must be flowing through R and Z.
	• 10 m

○ WORKSHEET: Explain what a Zener diode does in your own words. • NEW CONCEPT: Breadboards! Explain importance of breadboards. ○ DRAW: Connections in breadboards. ○ PASS AROUND: A breadboard with the backing open to show evidence of connections ○ GUIDE STUDENTS THROUGH: Converting simple circuits to layout on breadboard. 3 examples. Method: Circle nodes, check off as you place each component on the breadboard. ○ GUIDE STUDENTS THROUGH: Example with op-amp on breadboard – hooking up 8 pins to things. ○ WORKSHEET: 2 conversions of circuits to breadboard layouts • USE WEB APP: Students independently go through 5-10 breadboard layout challenges from assigned circuits. (Have 15 prepared) Be there to answer questions as students complete exercises. • DESIGN TIME: Design a circuit that can power one LED. ○ CHALLENGE: Now design a circuit that can power 5 LED's at once from one battery. ○ GROUP THINKING: A third of the class does the LED's in series circuits. A third of the class does the LED's in parallel circuits. A third of the class does the LED-resistor combos in parallel circuits. ○ ORDER: Make a hypothesis about what you think will happen for the circuit that you build. Then build it. Then record your results/observations. ○ DISCUSS: Reconvene and ask each group to report their results from their explorations. Why did certain circuits work and certain other circuits didn't work? • EXIT: Yay that's it! Everyone's exit ticket is a piece of paper with their (1) rating of the class, (2) list of up to three things they liked a lot, and (3) list of up to three things they didn't like and what they would like instead.	• 20 m • 40 m • 30 m • 5 m