EET103 – Series Circuits Follow-Up Lecture

1) Flashlight Circuit (Cells in Series + Lamp)

• 3×AA batteries (1.5 V each) in series → 4.5 V total
• Internal resistance: 0.2 Ω per cell → 0.6 Ω total
• Lamp: ~20 Ω

Total Resistance	R_T = 20.6 Ω
Current	I = 4.5 / 20.6 ≈ 0.218 A
Lamp Voltage	V_lamp ≈ 4.37 V
Lamp Power	P_lamp ≈ 0.95 W
Internal Loss	P_int ≈ 0.03 W

Discussion: As cells age, internal resistance increases, lamp dims. Ask students: What if r_int doubles?

2) Voltage Divider (Scaling 12 V to ~3.3 V)

• R1 = 26.7 kΩ, R2 = 10 kΩ
• Divider ratio: Vout = Vin × (R2 / (R1+R2))

Input (Vin)	12 V
Output (Vout)	≈ 3.27 V
Divider Current	≈ 0.327 mA

Discussion: Good example for ADC scaling. What happens if Vin = 14.4 V? How do we protect a 3.3 V ADC input?

3) Two LEDs in Series + Resistor

• Supply: 9 V battery
• LEDs: 2× red (Vf ≈ 2.0 V each)
• R = (9 – 4) / 0.015 ≈ 330 Ω

LED Current	≈ 15 mA
Resistor Power	≈ 0.08 W
LED Voltage Drop	≈ 4.0 V total

Discussion: Series LEDs share current equally. What if we replace with blue LEDs (Vf ≈ 3.0 V each)?