



8 Electrical and electronic principles

Criteria	Range	Resource identified
8.1 Principles of electrical and electronic systems.	Flow of electrons	https://electronicsclub.info/electron.htm https://www.allaboutcircuits.com/textbook/direct-current/chpt-1/conventional-versus-electron-flow/
	Charges	https://www.open.edu/openlearn/science-maths-technology/introduction-electronics/content-section-2.1 http://www.electronicandyou.com/what-is-charge-in-physics-and-electronics-electric-charge.html
	Energy	https://www.electronics-tutorials.ws/dccircuits/electrical-energy.html https://study.com/academy/lesson/what-is-electric-energy-definition-examples.html https://electronicsclub.info/power.htm#energy
	Power	https://electronicsclub.info/power.htm https://www.electronics-notes.com/articles/basic_concepts/power/what-is-electrical-power-basics-tutorial.php
	Networks	https://en.wikipedia.org/wiki/Electrical_network https://www.electricaltechnology.org/2014/01/important-terms-related-to-electric-circuits-and-networks.html#what-is-an-electrical-network https://www.electrical4u.com/electric-circuit-or-electrical-network/ https://www.electrically4u.com/basic-terms-in-electric-circuits-types-of-networks/
	Force	https://byjus.com/physics/electrical-force/ https://www.physicsclassroom.com/class/estatics/Lesson-3/Newton-s-Laws-and-the-Electrical-Force https://www.khanacademy.org/science/electrical-engineering/ee-electrostatics/ee-electric-force-and-electric-field/a/ee-electric-force
	Current	https://www.allaboutcircuits.com/textbook/direct-current/chpt-1/voltage-current/ https://www.youtube.com/watch?v=kcL2_D33k3o https://www.electronics-notes.com/articles/basic_concepts/current/what-is-electrical-current.php





Capacitance	https://electronicsclub.info/capacitance.htm
Waves	https://www.electronics-tutorials.ws/waveforms/waveforms.html https://www.electronics-tutorials.ws/accircuits/ac-waveform.html https://en.wikipedia.org/wiki/Square_wave#/media/File:Waveforms.svg
Conduction	https://energyeducation.ca/encyclopedia/Electrical_conductivity https://www.electronics-tutorials.ws/resistor/resistivity.html https://en.wikipedia.org/wiki/Electrical_resistivity_and_conductivity
Magnetism (flux density, field strength)	https://www.livescience.com/38059-magnetism.html https://www.britannica.com/science/magnetic-field https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields/magnetic-flux-faradays-law/a/what-is-magnetic-flux https://www.britannica.com/science/magnetic-flux-density
Inductance	http://hyperphysics.phy-astr.gsu.edu/hbase/electric/induct.html https://www.electronics-tutorials.ws/inductor/inductance.html
Standard units of measure	https://www.vedantu.com/physics/unit-of-electricity https://www.electronics-tutorials.ws/dccircuits/dcp_3.html https://www.electronics-lab.com/article/electrical-units-measure/
Voltage	https://electronicsclub.info/voltage.htm https://www.electronics-notes.com/articles/basic_concepts/voltage/what-is-voltage-basics-tutorial.php https://www.allaboutcircuits.com/textbook/direct-current/chpt-1/voltage-current/ https://www.youtube.com/watch?v=w82aSjLuD_8
AC and DC	https://electronicsclub.info/acdc.htm https://www.electronics-tutorials.ws/accircuits/ac-waveform.html https://www.youtube.com/watch?v=vN9aR2wKv0U https://www.youtube.com/watch?v=kcL2_D33k3o





Resistance	https://electronicsclub.info/resistance.htm
Potential dividers	https://www.electronics-tutorials.ws/dccircuits/voltage-divider.html https://electronicsclub.info/vdivider.htm https://kitronik.co.uk/blogs/resources/potential-divider-voltage-divider
Basic electrical elements	https://www.mathworks.com/help/physmod/simscape/electrical-elements.html?s_tid=CRUX_lftnav https://circuitspedia.com/active-and-passive-devices-unilateral-bilateral-linear-element/ https://en.wikipedia.org/wiki/Electrical_element
Ohm's law (series, parallel and combination circuits)	https://electronicsclub.info/ohmslaw.htm https://electronicsclub.info/resistance.htm https://www.open.edu/openlearn/science-maths-technology/introduction-electronics/content-section-2.2 https://www.electronics-tutorials.ws/resistor/res_5.html
Kirchhoff's current and voltage laws	https://www.electronics-tutorials.ws/dccircuits/kirchhoffs-current-law.html https://www.electronics-tutorials.ws/dccircuits/kirchhoffs-voltage-law.html https://isaacphysics.org/concepts/cp_kirchhoffs_laws?stage=all https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/a/ee-kirchhoffs-laws
Phasor diagrams	https://www.electronics-tutorials.ws/accircuits/phasors.html https://www.youtube.com/watch?v=zlmwvijn1Y https://www.youtube.com/watch?v=dOt3GhJLhJo https://learnabout-electronics.org/ac_theory/ac_ccts_53.php
Protection systems (lightning arrestors, time graded over current protection, distance protection)	https://electricalapprentice.co.uk/what-is-circuit-protection/ https://en.wikipedia.org/wiki/Lightning_arrester





Resistors, capacitors and inductors in series, parallel, and combined circuits	https://electronicsclub.info/capacitors.htm https://electronicsclub.info/resistors.htm https://www.electronics-tutorials.ws/resistor/res_5.html https://www.electronics-tutorials.ws/capacitor/cap_6.html https://courses.lumenlearning.com/physics/chapter/19-6-capacitors-in-series-and-parallel/ https://www.allaboutcircuits.com/textbook/direct-current/chpt-13/series-and-parallel-capacitors/ https://www.allaboutcircuits.com/textbook/direct-current/chpt-15/series-and-parallel-inductors/
Semiconductors (forward and reverse bias, N-type and P-type)	https://electronicsclub.info/transistors.htm http://hyperphysics.phy-astr.gsu.edu/hbase/Solids/dope.html https://courses.lumenlearning.com/introchem/chapter/semiconductors/ https://circuitglobe.com/difference-between-forward-and-reverse-biasing.html https://www.youtube.com/watch?v=STYLrmW8tmA https://www.electronics-tutorials.ws/diode/diode_3.html
Hierarchical design	https://resources.pcb.cadence.com/blog/introduction-to-hierarchical-schematic-design https://resources.altium.com/p/how-hierarchical-schematic-design-can-help-your-next-pcb-schematic-layout
Signal types (analogue, digital)	https://electronicsclub.info/analogue.htm https://learn.sparkfun.com/tutorials/analogue-vs-digital/all https://www.bbc.co.uk/bitesize/guides/zwd2bk7/revision/5
Signal waveforms (sinusoidal, square, rectangular, triangular, sawtooth)	https://www.electronics-tutorials.ws/waveforms/waveforms.html https://www.electronics-tutorials.ws/accircuits/ac-waveform.html https://en.wikipedia.org/wiki/Square_wave#/media/File:Waveforms.svg
Signal processing and conditioning	https://www.ni.com/en-gb/innovations/white-papers/09/what-is-signal-conditioning-.html https://blog.ttelectronics.com/signal-conditioning https://www.youtube.com/watch?v=HSHJXXFigz8





	Fan in and fan out	https://www.youtube.com/watch?v=QKVkgDnF46M https://www.youtube.com/watch?v=wPPGnQ6Mp4w https://whatis.techtarget.com/definition/fan-out https://whatis.techtarget.com/definition/fan-in
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