|  |  |  |
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| **10 Engineering and manufacturing control systems** | | |
| Criteria | Range | Resource identified |
| 10.1 Principles and applications of control system theory. | Input | https://www.bbc.co.uk/bitesize/guides/z4qdqhv/revision/3 |
|  | <https://www.electronics-tutorials.ws/io/io_1.html> |
|  | <https://electronicsclub.info/switches.htm> |
|  | <https://www.bbc.co.uk/bitesize/guides/zhxqmsg/revision/1> |
|  | <https://electronicsclub.info/other.htm> |
|  | Process (logic gates (AND, OR, NOT), timer, comparator, pulse unit, counter, latch) | <https://www.bbc.co.uk/bitesize/guides/z4qdqhv/revision/3> |
|  | <https://electronicsclub.info/gates.htm> |
|  |  |
|  | Output | <https://electronicsclub.info/other.htm#piezo> |
|  | <https://www.bbc.co.uk/bitesize/guides/z4qdqhv/revision/3> |
|  | <https://www.bbc.co.uk/bitesize/guides/zk37hyc/revision/9> |
|  | Signal | <https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_signals.htm> |
|  | <https://electronicsclub.info/acdc.htm#props> |
|  | <https://www.tutorialspoint.com/control_systems/control_systems_block_diagrams.htm> |
|  | Feedback | <https://www.electronics-tutorials.ws/systems/feedback-systems.html> |
|  | <https://www.electronics-tutorials.ws/systems/negative-feedback.html> |
|  | Open and closed loop systems | <https://www.electronics-tutorials.ws/systems/closed-loop-system.html> |
|  | <https://www.electronics-tutorials.ws/systems/open-loop-system.html> |
|  | <https://www.electronics-tutorials.ws/systems/electronic-system.html> |
|  | <https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm> |
|  | Transfer function | <https://www.electrical4u.com/transfer-function/> |
|  | <https://electronicscoach.com/transfer-function-of-control-system.html> |

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|  | Summing points | <https://www.tutorialspoint.com/control_systems/control_systems_block_diagrams.htm> |
|  | <https://www.electrical4u.com/block-diagrams-of-control-system/> |
|  | Analogue | <https://electronicsclub.info/analogue.htm> |
|  | Digital | <https://electronicsclub.info/analogue.htm> |
|  | Pulse width and amplitude modulation | <https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html> |
|  | <https://learn.sparkfun.com/tutorials/pulse-width-modulation/all> |
|  | <https://www.analogictips.com/pulse-width-modulation-pwm/> |
|  |  |
|  | How control systems are represented in diagrams | <https://electronicsclub.info/blockdiagrams.htm> |
|  | <https://www.electronics-tutorials.ws/systems/electronic-system.html> |
|  | <https://www.techtransfer.com/blog/basics-process-control-diagrams/> |
|  | <https://www.electrical4u.com/block-diagrams-of-control-system/> |
|  | <https://www.tutorialspoint.com/control_systems/control_systems_block_diagrams.htm> |
|  | Applications - Electrical | <https://www.electronicspoint.com/opinion/the-importance-of-control-systems-in-electrical-engineering/> |
|  | <https://www.designingbuildings.co.uk/wiki/Electrical_control_systems> |
|  | Applications - Pneumatic | <https://www.ekci.com/what-is-pneumatic.html> |
|  | <https://engineeringlearn.com/pneumatic-control-system/> |
|  | <https://whyps.com/applications-of-hydraulics-and-pneumatics> |
|  | Applications - Hydraulic | <https://whyps.com/applications-of-hydraulics-and-pneumatics> |
|  |
|  | Measured parameters (pressure flow, temperature, speed, position) | <https://clippard.com/cms/wiki/pressure-control-vs-flow-control> |
|  | <https://www.omega.co.uk/techref/flowcontrol.html> |
|  | <https://en.wikipedia.org/wiki/Temperature_control> |

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| 10.2 How sensors and actuators are used in automation control systems. | Sensors and actuators – types (analogue, digital, active, passive) | <https://circuitglobe.com/difference-between-active-and-passive-components.html> |
| <https://www.watelectrical.com/what-are-analog-sensors-types-and-their-characteristics/> |
| <https://www.electronics-tutorials.ws/io/io_1.html> |
| <https://www.watelectrical.com/what-are-digital-sensors-types-and-their-uses/> |
| https://www.reac-group.com/en\_en/facts/actuators/what-is-an-actuator/ |
| Applications (switches, proximity sensors, laser, vision systems) | <https://www.electronics-tutorials.ws/io/io_1.html> |
| <https://electronicsclub.info/switches.htm> |
| <https://en.wikipedia.org/wiki/Proximity_sensor> |
| Power sources | <https://www.allaboutcircuits.com/textbook/reference/chpt-9/power-sources/> |
| <https://www.engineersgarage.com/articles-basic-electronics-power-supply-types/> |
| <https://en.wikipedia.org/wiki/Power_supply> |
| <https://electronicsclub.info/powersupplies.htm> |
| Uses in automation – Position and volume of objects being processed | <https://www.manufacturingtomorrow.com/article/2020/03/how-are-mechatronics-and-industrial-automation-different/14947> |
| Mechanised lifting and moving of objects | <https://www.designingbuildings.co.uk/wiki/Lifting_device> |
| <https://www.newworldencyclopedia.org/entry/crane_(machine)> |
| Measurement applications (electrical, mechanical, thermal, chemical, biological, optical, acoustic, radiation) | <https://www.omega.co.uk/prodinfo/temperature-measurement.html> |
| <https://www.thomasnet.com/articles/instruments-controls/all-about-radiation-detectors/> |
| <https://en.wikipedia.org/wiki/Acoustical_measurements_and_instrumentation> |