T1 direct-current circuit analysis	T1 transient response	T1 charge
T1 coulombs	T1 conserved	T1 current
T1 amperes	T1 voltage	T1 volts

T1 An electrical property that causes attraction or repulsion.	T1 How a circuit behaves just after a sudden change, before it settles to a steady state.	T1 Finding the steady voltages and currents in a circuit whose sources do not change with time.
T1 The rate of flow of electric charge.	T1 Remaining constant in total within an isolated system or under the specified conditions.	T1 The SI unit of electric charge, equal to the charge transferred by a current of one ampere in one second.
T1 The SI unit of potential difference, equal to one joule of energy transferred per coulomb of charge.	T1 The energy transferred per unit electric charge.	T1 The SI unit of electric current, equivalent to one coulomb of charge passing per second.

T1 power	T1 watts	T1 energy
T1 joules	T1 kilowatt-hour	T1 passive sign convention
T1 ammeter	T1 Ohm's law	T1 resistor

T1 The capacity to do work or cause change.	T1 The SI unit of power, equal to one joule per second.	T1 The rate of energy transfer or work done.
T1 Taking current to enter a component at its + terminal, so positive power means the component absorbs energy.	T1 A unit of energy: one kilowatt used for one hour, equal to 3.6 million joules.	T1 The SI unit of energy and work.
T1 A component that opposes current, so the voltage across it is proportional to the current.	T1 The rule that current is proportional to potential difference across an ohmic conductor when physical conditions such as temperature are constant.	T1 An instrument connected in series to measure electric current.

T1 ohms	T1 conductance	T1 series
T1 parallel	T1 voltage divider	T1 current divider
T1 Kirchhoff's current law	T1 node	T1 Kirchhoff's voltage law

T1 An arrangement in which components lie along a single electrical path.	T1 The reciprocal of resistance, measured in siemens.	T1 Units of electrical resistance, with one ohm equal to one volt per ampere.
T1 Resistors in parallel that share a current, with more current through the smaller resistance.	T1 Two or more resistors in series that share a supply voltage in proportion to their resistances.	T1 An electrical arrangement in which components are connected across the same two points and have the same potential difference.
T1 The voltages around any closed loop of a circuit add up to zero.	T1 A set of circuit points joined by ideal conductors and therefore assigned the same node voltage.	T1 The total current flowing into a node equals the total current flowing out.

T1 loop	T1 nodal analysis	T1 reference node
T1 mesh analysis	T1 mesh current	T1 Thévenin's theorem
T1 open-circuit voltage	T1 Norton's theorem	T1 source transformation

T1 The node chosen as 0 volts, against which every other node voltage is measured.	T1 Solving a circuit by writing Kirchhoff's current law at each node in terms of node voltages.	T1 A closed path in a circuit or conducting wire through which current can circulate.
T1 Any linear two-terminal network behaves at its terminals like one voltage source in series with one resistance.	T1 A current imagined to flow around one loop of a circuit, used as an unknown in mesh analysis.	T1 Solving a planar circuit by writing Kirchhoff's voltage law around each mesh in terms of mesh currents.
T1 Swapping a voltage source with a series resistor for an equivalent current source with a parallel resistor.	T1 Any linear two-terminal circuit can be replaced by a current source in parallel with one resistance.	T1 The voltage between a port's terminals when no external load current flows through the port.

T1 superposition	T1 maximum power transfer	T1 operational amplifier
T1 gain-bandwidth product	T1 ideal op-amp	T1 negative feedback
T1 golden rules	T1 virtual short	T1 inverting amplifier

T1 A high-gain amplifier with two inputs, used with feedback to build amplifiers and filters.	T1 For a fixed resistive Thevenin source with positive resistance, the load receives maximum power when its resistance matches the source resistance.	T1 Voltage and current responses to independent sources add in a linear circuit; deactivate the other independent sources while retaining dependent sources.
T1 A control process in which a change triggers responses that oppose that change.	T1 A model with infinite differential gain, infinite input impedance and zero output impedance, used with appropriate operating assumptions.	T1 For a dominant-pole voltage-feedback op-amp model, the approximately constant product of noise gain and closed-loop bandwidth.
T1 An op-amp circuit whose output is the input times minus Rf over Rin.	T1 The equal-input-voltage approximation for an ideal op-amp operating linearly with suitable negative feedback; its inputs are not physically shorted.	T1 For ideal linear negative-feedback operation, input currents are zero and the two input voltages are equal.

T1 virtual ground	T1 non-inverting amplifier	T1 voltage follower
T1 summing amplifier	T1 saturation	T1 capacitor
T1 capacitance	T1 farads	T1 inductor

T1 A buffer configuration whose output follows its input, with unity closed-loop voltage gain in the ideal model.	T1 An op-amp circuit whose output is the input times 1 plus Rf over Rg, with the same sign.	T1 A point held near the reference potential by circuit action, such as feedback, without a direct ground connection.
T1 A component that stores separated electric charge and energy in an electric field.	T1 Output limiting when an amplifier reaches its available swing and no longer follows the linear gain relation.	T1 An amplifier configuration combining several input signals into a weighted output sum.
T1 A circuit component that stores energy in a magnetic field and opposes changes in its current through an induced voltage.	T1 SI units of capacitance; one farad corresponds to one coulomb per volt.	T1 Stored electric charge per unit potential difference between conductors.

T1 inductance	T1 henrys	T1 natural response
T1 step response	T1 time constant	T2 mathematical methods
T2 derivative	T2 integral	T2 rectangular pulse

T1 The source-free response determined by stored energy or initial conditions; it need not decay in every circuit.	T1 SI units of inductance; one henry produces one volt when current changes at one ampere per second.	T1 For a linear coil, magnetic flux linkage divided by current; it determines induced voltage from changes in current.
T2 The unit of this course on the mathematics engineers use: complex numbers, matrices, differential equations and transforms.	T1 The characteristic time for an exponential process to change by a factor of e; in decay, the quantity falls to one over e of its starting value.	T1 How a circuit responds when a source is suddenly switched on and then held constant.
T2 A signal that is constant for a set time and zero at all other times.	T2 Accumulation represented mathematically by integration; in a PID controller, integral action accumulates tracking error over time.	T2 The instantaneous rate of change of a function with respect to its input.

T2 complex number	T2 modulus	T2 argument
T2 euler's identity	T2 linear system	T2 matrix inverse
T2 determinant	T2 singular	T2 ordinary differential equations

T2 An angle describing the direction of a nonzero complex number from the positive real axis in the complex plane.	T2 The non-negative magnitude of a number; for a real number, its distance from zero.	T2 A number expressible as a real part plus an imaginary part, using i with i squared equal to minus one.
T2 The matrix that, multiplied by the original, gives the identity matrix; only non-singular square matrices have one.	T2 A set of linear equations to be solved together for several unknowns.	T2 The complex-exponential relation linking cosine and sine: exp(j theta) equals cos(theta) plus j sin(theta).
T2 Equations relating a function to its derivatives; the circuit switching laws.	T2 Describes a square matrix with determinant zero, which has no inverse.	T2 A scalar calculated from a square matrix that indicates properties such as invertibility and area or volume scaling.

T2 homogeneous	T2 particular	T2 initial condition
T2 laplace transform	T2 partial fractions	T2 poles
T2 fundamental	T2 fourier series	T2 orthogonality

T2 A specified starting value used to determine a particular solution of an equation or model.	T2 The particular solution: the part of a differential equation's solution that follows the input.	T2 Describes a differential equation whose input side is zero; its solution is the natural response.
T2 Singularities of a system function, typically roots of its denominator after cancelling common factors.	T2 Simpler rational expressions whose sum equals a given rational expression.	T2 An integral transform into a complex frequency variable; derivatives become algebraic expressions including initial-condition terms.
T2 A zero inner product over the specified interval, such as between distinct sine harmonics integrated over a common period.	T2 A representation of a periodic signal as a sum of harmonically related sinusoidal or complex-exponential components.	T2 The lowest-frequency component of a periodic signal.

T2 harmonic	T2 random variable	T2 probability distribution
T2 expectation	T2 variance	T2 standard deviation
T2 gradient	T2 divergence	T2 curl

T2 A description assigning probabilities to the possible values or ranges of a random variable.	T2 A numerical quantity whose value depends on the outcome of a random process.	T2 A component of a periodic signal at a whole-number multiple of the fundamental frequency.
T2 A measure of spread equal to the square root of the variance.	T2 A measure of spread based on the squared deviations of values from their mean.	T2 The probability-weighted average value of a random variable.
T2 A vector operation that measures how much a field circulates around each point.	T2 A vector operation that measures how much a field flows outward from each point.	T2 The spatial rate and direction of change of a quantity; for a scalar field its gradient points towards the steepest increase.

T3 digital logic design	T3 binary	T3 hexadecimal
T3 two's complement	T3 range	T3 overflow
T3 boolean algebra	T3 absorption	T3 de morgan's theorem

T3 A base-sixteen number system using digits zero to nine and letters A to F.	T3 A number system using base two, with the digits zero and one.	T3 The unit of this course on designing circuits from logic gates, flip-flops and state machines.
T3 A condition in which a result exceeds the range representable by the available storage or number format.	T3 The set or interval of values permitted or covered in a particular context.	T3 A signed binary representation whose highest bit carries negative weight; inverting the bits and adding one performs fixed-width negation.
T3 Breaking a complement bar changes AND to OR and vice versa: $(A \cdot B)' = A' + B'$.	T3 A Boolean simplification law in which combining a value with a term already containing it leaves the value unchanged, such as A OR (A AND B) equalling A.	T3 Algebra of logical values using operations such as AND, OR and NOT and their identities.

T3 karnaugh map	T3 don't-cares	T3 combinational logic
T3 multiplexer	T3 decoder	T3 adder
T3 half adder	T3 full adder	T3 hazards

T3 Logic whose outputs depend only on its present inputs, with no memory.	T3 Input cases whose output need not be specified for the design, allowing either value during logic simplification.	T3 A truth table laid out in Gray-code order so adjacent cells differ in exactly one variable.
T3 A logic circuit that adds binary numbers.	T3 An enabled binary decoder selects the output associated with its input code, using its specified active-high or active-low convention.	T3 A circuit that chooses one of several inputs and passes it to its output.
T3 Unwanted brief output changes caused by unequal signal-path delays in a logic circuit.	T3 A circuit that adds two bits and a carry-in, giving a sum bit and a carry-out.	T3 A logic circuit that adds two single binary digits and produces a sum bit and a carry bit.

T3

sequential logic

T3

latch

T3

flip-flops

T3

at the clock edge

T3

toggles

T3

excitation table

T3

finite state machine

T3

state diagram

T3

register

T3 Storage elements that update state at their specified clock events, usually an active clock edge.	T3 A one-bit memory circuit that follows its input while enabled and holds the value otherwise.	T3 Logic whose outputs depend on both present inputs and stored past states.
T3 A table that shows the inputs a flip-flop needs for each change from present state to next state.	T3 Changes a binary state to its opposite value.	T3 At the specified transition of a clock signal, subject to the device's setup and hold requirements.
T3 A group of storage elements holding a binary word, often loading its bits together on a clock event.	T3 A drawing of a state machine's states as circles and its transitions as labelled arrows.	T3 A system with a fixed number of states that moves between them according to its inputs.

T3 shift register	T3 ripple counter	T3 synchronous counter
T3 memory	T3 hardware description language	T3 synthesizable
T3 testbench	T3 moore machines	T3 mealy machines

T3 A counter in which every flip-flop is clocked by the same clock signal.	T3 A counter in which each flip-flop is clocked by the output of the one before it.	T3 A chain of flip-flops that moves stored bits one place along at each clock edge.
T3 Describes HDL code that tools can turn into real hardware, not only simulate.	T3 A language such as Verilog or VHDL used to describe and simulate digital circuits.	T3 Circuits that store data, such as registers, RAM and ROM.
T3 Finite-state machines whose outputs depend on the current state and current inputs.	T3 Finite-state machines whose outputs depend only on the current state.	T3 HDL code that applies inputs to a design in simulation and checks its outputs.

T4 ac circuit analysis	T4 phasor	T4 impedance
T4 complex power	T4 power factor	T4 power-factor correction
T4 natural frequency	T4 damping	T4 overdamped

T4 The AC version of resistance, a complex number that also includes the phase shift.	T4 A complex number that represents a sinusoid's amplitude and phase.	T4 Sinusoidal steady-state analysis via phasors and impedances.
T4 Adjusting reactive-power exchange or current-waveform shape to improve the ratio of real to apparent power.	T4 Real power divided by apparent power; for sinusoidal voltage and current this equals the cosine of their phase difference.	T4 Power in an AC circuit written as a complex number: real power plus j times reactive power.
T4 Damped so strongly that the system returns to rest slowly, without oscillating.	T4 The reduction of oscillation amplitude caused by energy transfer out of the oscillating system.	T4 A frequency at which a system oscillates freely after being disturbed.

T4

critically damped

T4

underdamped

T4

q factor

T4

resonance

T4

bandwidth

T4

filter

T4

bode plot

T4

corner frequency

T4

decibel

T4 A dimensionless measure of resonance sharpness; in the standard second-order model it is natural angular frequency divided by twice the decay rate.	T4 Damped lightly, so the system oscillates as it settles.	T4 Damped just enough to return to rest as fast as possible without overshooting.
T4 A circuit that passes some frequencies and reduces others.	T4 The width of a frequency band; for filter examples, the separation between the specified band-edge or half-power frequencies.	T4 Enhanced response near a natural frequency; the resonance condition and peak frequency depend on the circuit and measured response.
T4 A logarithmic unit for a ratio; for voltage gain, dB = 20 log10 of the ratio.	T4 A pole or zero break frequency where an asymptotic Bode slope changes; an isolated first-order low-pass pole is 3 dB down there.	T4 Plots of frequency-response magnitude, usually in decibels, and phase against a logarithmic frequency axis.

T4 two-port	T4 cascade	T5 electronics I
T5 modelling	T5 doping	T5 pn junction
T5 ideal model	T5 constant-drop model	T5 piecewise-linear model

T5 The unit of this course on diodes, transistors and basic amplifier circuits.	T4 Connecting stages one after another, so the output of one feeds the input of the next.	T4 A network described by voltages and currents at two terminal pairs.
T5 The boundary between p-type and n-type semiconductor, which lets current flow easily in one direction only.	T5 Adding small amounts of impurity atoms to a semiconductor to change how it conducts.	T5 Describing a real component or system with simple equations that keep its important behaviour.
T5 A device model built from straight-line pieces, such as a diode's turn-on voltage plus a resistance.	T5 A diode model that treats a conducting diode as a fixed voltage drop, about 0.7 V for silicon.	T5 A diode model that treats the diode as a perfect switch: zero voltage when on, zero current when off.

T5

exponential model

T5

half-wave rectifier

T5

bridge rectifier

T5

peak inverse voltage

T5

filter capacitor

T5

ripple

T5

zener diode

T5

bipolar junction transistor

T5

active region

T5 Four diodes arranged so that both halves of an AC wave come out with the same polarity.	T5 A rectifier producing output from one polarity or half-cycle of an AC input.	T5 A diode model with exponential current-voltage behaviour, usually based on the Shockley relation and stated temperature assumptions.
T5 A periodic variation remaining in a nominally steady electrical voltage or current, such as after rectification.	T5 A capacitor after a rectifier that smooths the output towards a steady DC voltage.	T5 The maximum reverse voltage a rectifier diode must survive without breaking down.
T5 Here, a BJT's forward-active region, with its base-emitter junction forward biased and base-collector junction reverse biased.	T5 A three-layer transistor in which a small base current controls a larger collector current.	T5 A diode intended for controlled reverse-breakdown operation, often used with current limiting as a voltage reference or regulator.

T5 MOSFET	T5 saturation region	T5 square-law model
T5 threshold	T5 bias point	T5 small-signal
T5 loop gain	T5 transimpedance amplifier	T5 gain-bandwidth product

T5 A long-channel MOSFET approximation in strong-inversion saturation where drain current is proportional to squared gate overdrive.	T5 In a MOSFET, the amplifier region where drain current is mainly set by gate voltage; in a BJT, the fully-on switching region.	T5 A transistor in which the gate voltage controls the current through a channel.
T5 Describes analysis of small changes around a bias point, where a non-linear device can be treated as linear.	T5 The steady DC voltages and currents at which a transistor sits when no signal is applied.	T5 A boundary value at which a specified effect begins or a decision changes.
T5 For a dominant-pole voltage-feedback op-amp model, the approximately constant product of noise gain and closed-loop bandwidth.	T5 An amplifier that turns an input current into an output voltage.	T5 The total gain around a feedback loop, which decides how much the feedback corrects errors.

T5 coupling capacitor	T5 Miller capacitance	T5 dominant pole
T6 signals and systems	T6 signal	T6 system
T6 linearity	T6 time invariance	T6 causality

T5 A pole whose effect dominates the response over the range of interest, often because it is well separated from faster poles.	T5 The effective capacitance seen at an amplifier port due to a capacitance between input and output; its value depends on gain.	T5 A capacitor that passes the AC signal between stages while blocking their DC levels.
T6 A rule or physical arrangement mapping input signals to output signals.	T6 A function of time or a discrete index representing information or a measured physical quantity.	T6 The unit of this course on describing signals and predicting how systems change them.
T6 A system is causal if its output at any time depends only on present and past inputs, not future ones.	T6 A system is time-invariant if delaying the input simply delays the output by the same time.	T6 A system is linear if scaling and adding inputs scales and adds the outputs in the same way.

T6 BIBO stability	T6 linear time-invariant	T6 impulse response
T6 convolution	T6 Fourier transform	T6 time-bandwidth trade-off
T6 Nyquist criterion	T6 aliasing	T6 anti-alias filter

T6 The zero-state output produced by a unit impulse: a Dirac impulse in continuous time or a unit sample in discrete time.	T6 A system satisfying both superposition and time invariance; its zero-state response is determined by its impulse response.	T6 The property that every bounded input produces a bounded output.
T6 The relationship that concentrating a signal more tightly in time generally requires a wider frequency spread, under the chosen width definitions.	T6 A tool that turns a signal in time into its spectrum of frequencies.	T6 An operation combining shifted weighted copies of signals; it gives the zero-state LTI output from input and impulse response.
T6 A filter attenuating unwanted out-of-band components before sampling to reduce aliasing.	T6 In sampling, different continuous-time frequency components becoming indistinguishable as discrete-time samples.	T6 In sampling, the rate condition for band-limited signals; in feedback control, the stability test using a loop-frequency plot and its unstable-pole count.

T6 system function	T6 poles and zeros	T6 frequency response
T6 difference equation	T6 z-transform	T6 unit circle
T7 electromagnetics	T7 divergence	T7 curl

T6 How a system's gain and phase change with the frequency of a sinusoidal input.	T6 Singularities and zeros of a reduced system function in its complex variable, such as s or z.	T6 A transform-domain input-output relation for a linear system, defined with zero initial conditions and the required convergence assumptions.
T6 A circle with radius one, usually centred at the origin.	T6 A transform for discrete-time signals, the sampled-signal version of the Laplace transform.	T6 A relation between discrete-time sequences at shifted indices, used to describe digital systems.
T7 A vector operation that measures how much a field circulates around each point.	T7 A vector operation that measures how much a field flows outward from each point.	T7 The study of electric and magnetic fields, their interactions with matter and their propagation as waves.

T7 Gauss's law	T7 potential	T7 capacitance
T7 boundary conditions	T7 Biot-Savart law	T7 Ampere's law
T7 magnetic flux	T7 inductance	T7 Lorentz force

T7 Stored electric charge per unit potential difference between conductors.	T7 The electric potential energy per unit charge at a point, measured in volts.	T7 The electric flux through a closed surface equals the enclosed charge divided by the permittivity of vacuum.
T7 For steady currents, the line integral of magnetic field strength around a closed path equals the enclosed current.	T7 A magnetostatic relation adding the magnetic-field contributions of steady current elements.	T7 Rules for how fields must match at the surface between two materials.
T7 The force on a moving charge from electric and magnetic fields: $F = q(E + v \times B)$.	T7 For a linear coil, magnetic flux linkage divided by current; it determines induced voltage from changes in current.	T7 A measure of the magnetic field passing through a surface, accounting for field strength, area and orientation.

T7

displacement current

T7

plane wave

T7

intrinsic impedance

T7

Poynting vector

T7

skin depth

T7

good conductor

T7

telegrapher equations

T7

characteristic impedance

T7

bounce diagram

T7 The ratio of electric to magnetic field strength in a plane wave travelling through a material.	T7 An electromagnetic wave whose fields are uniform across flat planes at right angles to its direction.	T7 The term for a changing electric field, which produces a magnetic field just as a current does.
T7 A material in which conduction current is much larger than displacement current at the frequency used.	T7 The depth into a conductor at which an AC field has fallen to about 37% of its surface value.	T7 The electromagnetic energy-flux density E cross H, measured in watts per square metre.
T7 A time–distance diagram that tracks reflected waves travelling back and forth on a transmission line.	T7 The ratio of voltage to current for a wave travelling along a transmission line.	T7 The pair of equations that describe how voltage and current change along a transmission line.

T7 cutoff frequency	T7 guide wavelength	T7 dipole
T7 Friis equation	T8 microprocessors and embedded systems	T8 microcontroller
T8 fetch-decode-execute cycle	T8 program counter	T8 bus

T7 An antenna based on two conducting arms, often about half a wavelength long in total.	T7 The distance along a waveguide over which a propagating mode's phase advances by one full cycle.	T7 The threshold frequency separating propagating and evanescent behaviour for a specified waveguide mode.
T8 A small computer on one chip, with processor, memory and input/output, built to control a device.	T8 The unit of this course on how processors work and how they are programmed to control hardware.	T7 A free-space far-field link relation connecting received power to transmitted power, antenna gains and wavelength under stated matching and polarisation assumptions.
T8 A shared set of wires that carries data, addresses or control signals between parts of a computer.	T8 The register that holds the address of the next instruction to fetch.	T8 The processor sequence of obtaining an instruction, interpreting it and carrying it out.

T8 clock	T8 memory-mapped register	T8 assembly
T8 polling	T8 GPIO	T8 memory-mapped I/O
T8 interrupt	T8 interrupt service routine	T8 timer

T8 A processor-specific programming language using symbolic instruction names and operands.	T8 A hardware control register that software reads or writes at a fixed memory address.	T8 A regular square-wave signal that tells a digital circuit when to update.
T8 Accessing device registers through addresses in the processor's memory address space.	T8 General-purpose input/output pins on a microcontroller that software can read or drive.	T8 Having software check a device's status again and again to see whether it needs attention.
T8 A hardware counter in a microcontroller used to measure time or produce regular events.	T8 A routine invoked to handle an accepted interrupt, after which execution may return to the interrupted context.	T8 An event request that can transfer execution to a handler when enabled and accepted by the processor.

T8 prescaler	T8 UART	T8 SPI
T8 I2C	T8 baud rate	T8 ADC
T8 resolution	T8 LSB	T8 DAC

T8 A synchronous serial peripheral interface using a clock and separate data lines, with device selection controlled by the host.	T8 A universal asynchronous receiver-transmitter that frames serial data using start and stop bits without a separate shared clock line.	T8 A counter that divides a clock frequency down before it reaches a timer.
T8 Analogue-to-digital converter: a circuit that turns a voltage into a binary number.	T8 Symbols transmitted per second; in the binary UART examples, one symbol carries one bit.	T8 An addressed serial bus using shared serial-data and serial-clock lines.
T8 A digital-to-analogue converter producing an analogue electrical output from a digital code.	T8 Least significant bit: the rightmost bit, with the smallest place value.	T8 The smallest distinguishable change; in an ADC this concerns quantisation steps, while in spectrum analysis it concerns separating frequency components.

T8 watchdog	T8 debounce	T9 electrical machines and power systems
T9 magnetomotive force	T9 flux	T9 reluctance
T9 air gap	T9 hysteresis	T9 eddy current

T9 The study of motors, generators and transformers, and of the networks that carry electrical energy from generators to users.	T8 Removing the rapid false on–off pulses a mechanical switch makes when pressed.	T8 A timer requiring regular servicing that can request a reset or other recovery action if servicing stops.
T9 The opposition of a magnetic circuit to magnetic flux, like resistance in an electric circuit.	T9 The total magnetic field passing through an area, measured in webers.	T9 The driving force for magnetic flux in a magnetic circuit, equal to the number of coil turns times the current.
T9 A circulating current induced within conducting material by changing magnetic flux.	T9 Dependence of a magnetic material's state on its previous magnetisation history.	T9 A nonmagnetic gap in a magnetic circuit, often contributing much of its reluctance.

T9 transformer	T9 core loss	T9 copper loss
T9 open-circuit test	T9 short-circuit test	T9 armature
T9 commutator	T9 shunt motor	T9 series motor

T9 Resistive power loss in windings, calculated as current squared times resistance for the stated current convention.	T9 The power lost as heat in the iron core of a machine or transformer, from hysteresis and eddy currents.	T9 A device that changes alternating potential difference using electromagnetic induction between coils.
T9 The winding carrying working current and developing induced EMF; in the DC machine here it is on the rotor.	T9 A reduced-voltage transformer test with a shorted winding, commonly used at rated current to estimate series impedance and winding loss.	T9 A transformer test with an open secondary, commonly used at rated voltage to estimate excitation and core-loss behaviour.
T9 A DC motor whose field winding carries the armature current in series, with a risk of overspeed under very light loading.	T9 A DC motor whose field winding is connected in parallel with the armature supply.	T9 A segmented mechanical switching assembly connecting a DC machine's rotating windings to stationary brushes.

T9 field weakening	T9 rotating field	T9 synchronous speed
T9 slip	T9 squirrel-cage	T9 wound rotor
T9 breakdown torque	T9 synchronous machine	T9 power angle

T9 The rotational speed of the fundamental rotating magnetic field, set by supply frequency and pole count.	T9 A magnetic field whose direction rotates in space, commonly produced by balanced polyphase stator currents.	T9 Reducing magnetic field strength to permit operation above base speed, with reduced torque capability for a given current.
T9 An induction-machine rotor with windings connected through slip rings, allowing external circuit connections.	T9 An induction-machine rotor with conducting bars joined by end rings.	T9 The signed difference between synchronous and rotor speeds divided by synchronous speed; generating operation can have negative slip.
T9 The phase-angle difference between a synchronous machine's internal EMF and the relevant bus or terminal voltage.	T9 An AC machine whose rotor runs at synchronous speed during steady synchronous operation.	T9 The maximum electromagnetic torque on the specified steady-state induction-machine torque-speed curve.

T9 excitation	T9 infinite bus	T9 static margin
T9 per-unit	T9 base value	T9 fault current
T9 power flow	T9 slack bus	T9 reactive compensation

T9 The separation between operating power and a model's steady-state transfer limit, using the specified absolute or relative convention.	T9 An ideal power-system bus whose voltage magnitude and frequency remain fixed despite the connected machine's power exchange.	T9 The field-producing input to a machine, affecting its internal EMF and reactive-power behaviour.
T9 The current flowing during a specified electrical fault, determined by the source and network impedances.	T9 A chosen reference quantity used to express an actual quantity in per-unit form.	T9 A way of writing a quantity as a fraction of a chosen base value, so values at different voltage levels can be compared.
T9 Adding or controlling reactive-power exchange to support voltage regulation or reduce unwanted reactive current.	T9 The power-flow reference bus fixing voltage angle and balancing the model's real and reactive power mismatch.	T9 The calculation of voltages and real and reactive power at every bus of a power network in steady state.

T9 buck	T9 boost	T9 duty cycle
T9 continuous conduction	T9 volt-second balance	T9 synchronous rectification
T10 control systems	T10 feedback	T10 plant

T9 Switch on-time divided by the switching period.	T9 A DC–DC converter that gives an output voltage higher than its input voltage.	T9 A DC–DC converter that gives an output voltage lower than its input voltage.
T9 Using controlled transistors in place of rectifier diodes to carry the required current paths.	T9 Zero net inductor-voltage integral over a switching period at periodic steady state.	T9 A converter mode with no zero-current interval in its storage inductor; in the unidirectional examples its current remains positive.
T10 The physical process or device to be controlled, such as the motor in the course model.	T10 Information about an outcome returned to a person or system to guide subsequent action.	T10 Systems arranged to make selected outputs follow desired behaviour through control actions, with or without feedback.

T10 transfer function	T10 state variable	T10 time constant
T10 back-EMF	T10 linearization	T10 operating point
T10 natural frequency	T10 block diagram	T10 characteristic equation

T10 The characteristic time for an exponential process to change by a factor of e; in decay, the quantity falls to one over e of its starting value.	T10 One of the variables whose present values, together with future inputs, determine a dynamic model's future evolution.	T10 The ratio of the Laplace transform of a system output to that of its input, with zero initial conditions.
T10 The steady condition of a system around which a model is linearized.	T10 Approximating a nonlinear system by a linear model near a specified operating point.	T10 An induced voltage in a motor that opposes the applied driving voltage under the stated sign convention.
T10 The equation whose roots determine a linear model's natural modes or closed-loop poles.	T10 A drawing that shows a system as connected blocks, each with its own transfer function.	T10 A frequency at which a system oscillates freely after being disturbed.

T10 damping ratio	T10 step response	T10 overshoot
T10 peak time	T10 settling time	T10 rise time
T10 steady-state error	T10 system type	T10 velocity error constant

T10 The amount by which a step response rises above its final value, usually given as a percentage.	T10 How a circuit responds when a source is suddenly switched on and then held constant.	T10 Damping normalised by critical damping in a standard second-order model.
T10 The time for a response to move between specified fractions of its final change, such as 10% and 90%.	T10 The time a response takes to stay within a small band, often 2%, of its final value.	T10 The time of the specified response peak, usually the first peak in the standard underdamped step response.
T10 For the standard unity-feedback model, the low-frequency limit of s times loop transfer function, used to evaluate ramp-tracking error.	T10 The number of uncancelled integrators in the specified loop transfer function for the standard tracking-error classification.	T10 The difference between the desired output and the actual output after the response has settled.

T10

Routh array

T10

auxiliary equation

T10

marginal stability

T10

root locus

T10

asymptote

T10

breakaway point

T10

phase margin

T10

gain crossover

T10

gain margin

T10 A free response remaining bounded without fully decaying; this does not by itself imply BIBO stability.	T10 The polynomial formed from the row above an all-zero row in a Routh array, used to analyse its symmetric root factor.	T10 A table built from the characteristic polynomial that shows how many poles lie in the right half-plane.
T10 A point on the real axis where two branches of the root locus meet and leave the axis.	T10 A line that a curve approaches arbitrarily closely as its input or output tends to a particular limit.	T10 A plot of how the closed-loop poles move in the s-plane as a gain changes from zero to infinity.
T10 The gain multiplier taking loop magnitude to unity at a minus-180-degree phase crossing, often expressed in decibels.	T10 A frequency where the loop-transfer magnitude is one, or zero decibels.	T10 At a gain crossover, the signed phase separation of the loop response from minus 180 degrees under the chosen convention.

T10 phase crossover	T10 Nyquist criterion	T10 encirclement
T10 PID controller	T10 proportional	T10 integral
T10 derivative	T10 lead compensator	T10 anti-windup

T10 A net traversal around a specified point in the complex plane, counted with its direction convention.	T10 In sampling, the rate condition for band-limited signals; in feedback control, the stability test using a loop-frequency plot and its unstable-pole count.	T10 A frequency where loop phase reaches minus 180 degrees modulo a full turn, under the specified convention.
T10 Accumulation represented mathematically by integration; in a PID controller, integral action accumulates tracking error over time.	T10 Controller action proportional to the present error or specified measured signal.	T10 A controller that adds proportional, integral and derivative actions on the error signal.
T10 Measures limiting unwanted integrator accumulation when actuator saturation prevents the requested control action.	T10 A compensator providing positive phase over a chosen frequency range, often used to improve the loop response.	T10 Controller action responding to the rate of change of error or a specified measured signal.

T10 state space	T10 eigenvalue	T10 transition matrix
T10 controllability	T11 communication systems	T11 bandwidth
T11 sideband	T11 amplitude modulation	T11 modulation index

T10 The matrix that maps the state at an initial time to the state at a later time when there is no input.	T10 A scalar by which a matrix scales a nonzero eigenvector; state-matrix eigenvalues determine linear model modes.	T10 A model that describes a system with first-order matrix equations in its state variables.
T11 The width of a frequency band; for filter examples, the separation between the specified band-edge or half-power frequencies.	T11 Systems encoding, transmitting and recovering information through physical channels.	T10 The ability to drive a state-space model from any initial state to a desired final state using allowed inputs over a finite interval.
T11 A measure of modulation depth; in conventional sinusoidal AM it is the message amplitude relative to the carrier envelope offset.	T11 Modulation in which the carrier amplitude varies according to a message signal.	T11 A spectral component or band produced on one side of a carrier by modulation.

T11 envelope detector	T11 instantaneous frequency	T11 frequency deviation
T11 Carson's rule	T11 noise figure	T11 quantisation
T11 raised-cosine	T11 constellation	T11 entropy

T11 The specified departure of instantaneous frequency from the unmodulated carrier, often quoted as its peak value.	T11 The time derivative of signal phase divided by two pi, with phase measured in radians.	T11 A circuit recovering suitable amplitude-modulated signals by following their envelope, subject to bandwidth and modulation-depth conditions.
T11 Mapping a continuous range of amplitudes to a finite or countable set of levels.	T11 A logarithmic measure of signal-to-noise degradation through a device or cascade under specified reference conditions.	T11 An approximate FM bandwidth estimate: twice the sum of peak frequency deviation and highest message frequency.
T11 A source's average surprise in bits per symbol: H = -sum p log2 p; the gap to fixed-length coding is redundancy.	T11 A set of signal-symbol points represented in a signal space such as the in-phase/quadrature plane.	T11 A pulse-shaping response with a cosine roll-off, designed to meet the Nyquist zero-intersymbol-interference condition.

T11 channel capacity	T11 Hamming code	T12 digital signal processing
T12 impulse response	T12 convolution	T12 causality
T12 BIBO stability	T12 frequency response	T12 DTFT

T12 Analysing and transforming discrete-time signals using numerical computation.	T11 A single-error-correcting block code; (7,4) adds 3 parity bits to 4 data bits.	T11 The limiting rate below which information can be communicated with arbitrarily small error under the specified channel model and constraints.
T12 A system is causal if its output at any time depends only on present and past inputs, not future ones.	T12 An operation combining shifted weighted copies of signals; it gives the zero-state LTI output from input and impulse response.	T12 The zero-state output produced by a unit impulse: a Dirac impulse in continuous time or a unit sample in discrete time.
T12 The discrete-time Fourier transform, representing a sequence by a continuous frequency function periodic in angular frequency with period two pi.	T12 How a system's gain and phase change with the frequency of a sinusoidal input.	T12 The property that every bounded input produces a bounded output.

T12 DFT	T12 leakage	T12 resolution
T12 FFT	T12 butterfly	T12 twiddle factor
T12 FIR	T12 Hamming window	T12 linear phase

T12 The smallest distinguishable change; in an ADC this concerns quantisation steps, while in spectrum analysis it concerns separating frequency components.	T12 Spectral spreading caused by observing a signal through a finite window, particularly when a tone does not align with DFT bins.	T12 The discrete Fourier transform mapping N sequence values to N complex frequency coefficients.
T12 A complex exponential weighting factor, typically a root of unity, used in DFT and FFT computations.	T12 A small repeated computation combining transform branches using additions, subtractions and weighting factors in an FFT.	T12 A family of fast algorithms for computing the discrete Fourier transform, commonly with work proportional to N log N.
T12 A frequency response with phase linear in frequency on regions where it is defined, giving constant group delay there.	T12 A tapered cosine window reducing spectral sidelobes at the cost of a wider main lobe than a rectangular window.	T12 A linear filter with a finite-duration impulse response.

T12 IIR	T12 bilinear transform	T12 prewarp
T12 decimation	T12 interpolation	T12 polyphase
T12 processing gain		

T12 Adjusting analogue prototype frequencies so the bilinear transform places selected critical frequencies at intended digital values.	T12 A mapping between analogue and digital system functions that maps the open left-half s-plane into the interior of the unit circle.	T12 A linear filter whose impulse response can continue indefinitely, commonly implemented with feedback.
T12 Decomposing filter coefficients into interleaved phases to implement rate changes or filtering efficiently.	T12 Increasing sample rate by inserting intermediate samples, commonly using zero insertion followed by an interpolation filter.	T12 Reducing sample rate, usually by low-pass filtering followed by keeping one sample from each group of a specified size.
		T12 Improvement in a specified noise or detection metric from processing such as coherent averaging, dependent on signal, noise and normalisation.