

Technical Repertoire – Areas, Groups, and Topics

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- [47 Molecular biology methods](#)
- [48 Cell and microbiology methods](#)

[49 Plant and animal biology methods](#)
[50 Biomedical devices, instrumentation, and imaging](#)
[51 Field work and outdoor skills](#)
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99 Other

00 Broad overviews of technical resources

This heading is mainly for categorizing books and other reference materials that provide a broad awareness of technical options.

- a How things work
- b How things are made
- c Inventions
- d Artifacts, useful objects, and dictionaries of things
- e Industries and occupations
- f Future society and technologies
- g Applied physics overviews
- h Engineering overviews
- i Technology overviews
- j Scientific instruments and apparatus overviews

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01 Design and early prototyping

- a Estimation and dimensional analysis
- b Requirements discovery, specification, and refinement
- c Systems thinking in design
- d Models of the engineering design process
- e Industrial engineering & design aesthetics
- f Reverse engineering
- g Design research
 - 01 Literature search
 - 02 Patent search
 - 03 Design source books and handbooks
 - 04 Designers resource websites
 - .01 [Hyperphysics](#)*
 - .02 [Engineering Toolbox](#)*
 - .03 [Engineering 360 / GlobalSpec](#)*
 - 05 Manufacturers' websites and catalogs
 - 06 Device data sheets
 - 07 Equipment manuals
- h Design and development record keeping
 - 01 Development notebooks
 - 02 Photo documentation
 - 03 Code commenting
 - 04 Data sheets and design specification documents
 - 05 User manual writing and illustration
- i Design drawings
 - 01 Sketching and drawing
 - .01 [Pencil and paper freehand drawing](#)*
 - .02 [Raster graphics application software](#)*
 - .03 [Vector graphics application software](#)*
 - 02 Drafting
 - 03 Tolerancing and dimensioning
 - 04 2D CAD and standard file types
 - 05 3D CAD and standard file types
 - 06 Assembly drawings and animations
 - 07 Schematics
 - .01 [Electrical](#)*
 - .02 [Pneumatic](#)*
 - .03 [Plumbing](#)*
 - 08 System block diagrams
 - 09 Technical illustration
 - 10 Patent drawings
- j Design repositories (GitHub, etc.)
- k Open design
- l Graphic, poster, brochure and exhibit design
- m Engineering analysis & simulation software
 - 01 Stress
 - 02 Flow
 - 03 Concentration
 - 04 Temperature
 - 05 Electromagnetic fields

- 06 Optical ray tracing
- 07 System dynamics
- 08 Circuit simulation
- n Making mockups and early prototypes
 - 01 Use of paper, cardboard & other art supplies
 - 02 Scale models
 - 03 Toy construction kits
 - 04 Tinkering and repurposing to create prototypes
- o Design for x
 - 01 Usability
 - 02 Sustainability
 - 03 Manufacturability
 - 04 Assembly
 - 05 Reliability and maintainability
 - 06 Developing economies
- p Human factors and universal design
- q Nature-inspired (biomimetic) design

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02 Safety and hazardous materials

- a Trauma and injury modeling
- b First aid
 - 01 Cuts and lacerations
 - 02 Major bleeding
 - 03 Object in eye
 - 04 Broken limbs & sprained joints
 - 05 Internal injury
 - 06 Burns
 - 07 Chemical burns
 - 08 Hypothermia
 - 09 Shock
 - 10 Electrical shock
 - 11 Resuscitation: CPR, AED's, etc.
 - 12 Poisons: ingested, inhaled
- c Specific safety issues
 - 01 Fire
 - 02 Torch and burner
 - 03 Explosion
 - 04 Hot object and hot fluid
 - 05 Cold object and cold fluid
 - 06 Electrical shock and burn
 - 07 Lifting
 - 08 Slipping and falling
 - 09 Crushing and falling object
 - 10 Sharp object & ejecta
 - 11 Eyes
 - 12 Rapid egress and accidental shut-in
 - 13 Machinery
 - 14 Laser
 - 15 Intense and invisible light
 - 16 Sound and ultrasound
 - 17 Distraction
 - 18 Electromagnetic field
 - 19 Magnet
 - 20 Lightning
 - 21 Radiation
 - 22 Toxic gas and asphyxiation
 - 23 Particulates
 - 24 Chemical burns
 - 25 Chemical toxicity
 - 26 Biohazard
 - 27 Food
 - 28 Sports
 - 29 Human assault
 - 30 Active shooter
 - 31 Animals
 - 32 Geohazards
- d Safety locations and their operating rules
 - 01 Laboratory
 - 02 Shop
 - 03 Studio

- 04 Classroom
- 05 Home
- 06 Vehicle
- 07 Construction site
- 08 Water (pool, river, lake, ocean)
- 09 Medical facility
- 10 Farm
- 11 Outdoors
- e Safety signs and labels
 - 01 Emergency contacts and procedures
 - 02 Evacuation routes and exit signs
 - 03 NFPA Hazard Identification signs
 - 04 Specific hazard signs
 - .01 *Laser-in-use*
 - .02 *Radiation hazard*
 - .03 *Wet floor*
 - 05 Container labels
- f Personal protective equipment (PPE)
 - 01 Clothing & aprons
 - 02 Gloves
 - 03 Helmets
 - 04 Glasses & goggles
 - 05 Face shields
 - 06 Back braces
 - 07 Knee shin elbow pads
 - 08 Shoes and boots
 - 09 Dust masks
 - 10 Respirators
 - 11 Ear plugs or earmuffs
- g Hazard detection and alarms
 - 01 Fire & smoke detectors
 - 02 Hazardous gas detectors
 - 03 Invisible light indicators
 - 04 Light meters
 - 05 Sound level meters
 - 06 Ventilation flow meter
 - 07 General alarm switches
 - 08 Intrusion alarm
 - 09 Geiger counter
 - 10 Radiation dose meter
- h Emergency response equipment
 - 01 Fire extinguishers
 - 02 Fire suppression system (sprinklers etc.)
 - 03 Fire blanket
 - 04 Emergency lighting
 - 05 Hand rinse water
 - 06 Eye wash
 - 07 Shower
 - 08 Escape ladders
 - 09 Spill clean-up kits (e.g. for mercury)
- i Other safety equipment
 - 01 Good lighting (building code)

- 02 Good ventilation (building code)
- 03 Anti-skid mats
- 04 Fire doors
- 05 Access control
- 06 Motion sensors
- 07 CCTV monitors
- 08 Safety shields
- 09 Moving machinery covers
- 10 Secure mounts for gas cylinders
- 11 Fume hood
- 12 Glove box
- 13 Remote manipulators
- 14 Fume and smoke snorkel
- 15 Laser cutter exhaust duct
- 16 Dust collectors
- 17 Pump and compressor exhaust oil filters
- 18 Room air purge
- 19 Eyeglass sanitizer
- 20 Autoclave
- 21 Pipette bulbs & siphon pumps
- 22 Sharps disposal containers
- 23 Heat sinks or holders for hot tools
- 24 Grounded outlets
- 25 Ground fault interrupters
- 26 Fuses and circuit breakers
- 27 Overheat cutoff switches
- 28 Motion limit switches
- 29 Equipment cover interlock switches
- 30 Pressure relief valves
- j Hazardous materials
 - 01 Material Safety Data Sheets
 - 02 Hazardous waste disposal
 - 03 Chemical spills
- k Disaster preparedness
 - 01 Emergency communications
 - 02 Emergency warning systems
 - 03 Emergency evacuations
 - 04 Emergency shelters
 - 05 Tornado
 - 06 Hurricane and typhoon
 - 07 Earthquake
 - 08 Wildfire
 - 09 Flood
 - 10 Tsunami
 - 11 Landslide
 - 12 Bomb
 - 13 Epidemic or large-scale biohazard

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03 Hand tools and handheld power tools

a Hand tools

- 01 Torque applying hand tools
 - .01 *Screwdrivers*
 - .02 *Nut drivers*
 - .03 *Allen keys*
 - .04 *Fixed wrenches*
 - .05 *Adjustable wrenches*
- 02 Grasping and holding hand tools
 - .01 *Tweezers*
 - .02 *Tongs*
 - .03 *Pliers*
 - .04 *Vise-grips*
- 03 Impacting hand tools
 - .01 *Hammers*
 - .02 *Punches*
 - .03 *Chisels*
- 04 Force concentrating tools for cutting
 - .01 *Knives*
 - .02 *Scissors and shears*
 - .03 *Awls*
 - .04 *Bores*
 - .05 *Tubing cutters*
 - .06 *Metal & plastic saws*
 - .07 *Abrasive saws*
 - .08 *Wood saws*
 - .09 *Wire cutters & strippers*
 - .10 *Diagonal cutters*
 - .11 *Sheet metal shears*
 - .12 *Sheet metal nibblers*
 - .13 *Greenlee punches*
- 05 Force concentrating tools for material removal
 - .01 *Files*
 - .02 *Planes*
 - .03 *Abrasive papers*
 - .04 *Abrasive saws*

b Clamps, jigs and fixtures

- 01 Clamps
 - .01 *C-clamps*
 - .02 *Spring clamps*
 - .03 *Wood clamps*
- 02 Bench vises
- 03 Hobby and precision-work vises
- 04 Portable work-tables

c Jacks, winches, presses, and rams

See 16 Rigging, materials handling & storage for jacks and winches

See 21 Vacuum and high pressure for presses & rams

d Handheld electric power tools

- 01 Power screwdriver
- 02 Drills
- 03 Circular saw
- 04 Reciprocating saw

- 05 Saws-all
- 06 Rotary cutter – abrasive cutter
- 07 Sander
- e Handheld air power tools
 - 01 Torque driver
 - 02 Impact wrench
 - 03 Drills
 - 04 Hammers
 - 05 Sanders
 - 06 Cutters
- f Fine working and specialty hand tools
 - 01 Magnifiers and loupes
 - 02 Fine tweezers
 - 03 Jewelers files
 - 04 Fine saws
 - 05 Fine screwdrivers
 - 06 Fine wrenches
 - 07 Precision cutting and carving tools
 - 08 Scalpels
 - 09 Dissecting tools
 - 10 Watchmakers tools
- g Fine working and specialty power tools
 - 01 High speed rotary tool
 - 02 Engraver
 - 03 Fine scroll saw
- h Outdoor tools - hand
 - 01 Shovels
 - 02 Post hole diggers
 - 03 Earth augers
 - 04 Rakes
 - 05 Pitchforks
 - 06 Tree saws
 - 07 Scythes & weed cutters
 - 08 Axes
 - 09 Picks
 - 10 Fencing tools
 - .01 Fence pullers*
 - .02 Post pounders*
 - .03 Fence wire cutters*
- i Outdoor tools – power
 - 01 Mowers
 - 02 String trimmers
 - 03 Hedge cutters
 - 04 Leaf blowers
 - 05 Chain saws
 - 06 Wood chippers

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04 Materials

- a Metals
 - 01 Standard stock shapes and sizes
 - 02 Steels
 - 03 Aluminum alloys
 - 04 Copper alloys
 - .01 *Copper*
 - .02 *Brass*
 - .03 *Bronze*
 - 05 Titanium
 - 06 Magnesium
 - 07 Zinc
 - 08 Tin
 - 09 Lead
 - 10 Refractory metals
 - .01 *Niobium*
 - .02 *Molybdenum*
 - .03 *Tantalum*
 - .04 *Tungsten*
 - .05 *Rhenium*
 - 11 Noble and precious metals
 - .01 *Gold*
 - .02 *Silver*
 - .03 *Platinum*
 - .04 *Palladium*
 - .05 *Iridium*
 - .06 *Osmium*
 - .07 *Rhodium*
 - .08 *Ruthenium*
 - 12 Other metals
- b Ceramics, gems and glasses
- c Semiconductor materials
- d Polymers – plastics and elastomers
 - 01 Thermoplastics
 - 02 Thermosets
 - 03 Elastomers
- e Polymer Composites
 - 01 Polymer matrix
 - 02 Metal matrix
 - 03 Ceramic matrix
 - 04 Carbon fiber
- f Wood and textiles
- g Soft & fluid materials
- h Structured materials
- i Biomaterials
 - See 50 Biomedical devices...***
- j Materials physical properties
- k Materials mechanical properties and continuum mechanics
 - See also 10 Structural systems: strength of materials***
 - 01 *Tensile testing*

- l Materials electrical and magnetic properties
 - See 23 Electronics design and construction*
 - See 24 Radio frequency and microwave systems*
 - See 39 Magnetic fields and superconductors*
- m Materials optical properties
 - See 36 Optics and optical systems*
- n Materials failure
 - 01 Fracture
 - 02 Fatigue
 - 03 Corrosion
 - 04 Biodegradation
- o Nondestructive testing
- p Materials in harsh environments

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05 Fabrication

- a Layout and markup techniques
- b Machining – traditional
 - 01 Drill press
 - 02 Band saw
 - 03 Cutoff saw
 - 04 Milling machine
 - 05 Lathe
 - 06 Grinder
 - 07 Sander
- c Machining – CNC and other advanced methods
 - 01 CNC mill
 - 02 CNC lathe
 - 03 Electric discharge machining
 - 04 Plasma cutting
 - 05 3D metal printing
- d Sheet metal work
 - 01 Sheet metal layout
 - 02 Cutting
 - 03 Bending
 - 04 Pressing
 - 05 Stamping
- e Metal casting & sintering
- f Metal forming
 - 01 Forging
 - 02 Extrusion
 - 03 Drawing
 - 04 Explosive forming
- g Metal joining
 - 01 Soldering
 - 02 Vacuum brazing
 - 03 Welding
 - 04 Cold welding
- h Plastic forming
 - 01 Casting
 - 02 Molding
 - 03 Hot forming
 - 04 Injection molding
 - 05 Blow molding
- i 3D Printing
- j 3D Scanners
- k Laser cutting & etching
- l Woodworking
 - 01 Table saw
 - 02 Rotary saw
 - 03 Router
 - 04 CNC router
 - 05 Planer
 - 06 Sander
- m Wood joints

- n Glass work and glass blowing
- o Ceramic forming
 - 01 Hand throwing and forming on pottery wheels
 - 02 Raku and built-up ceramics
 - 03 Slip casting
 - 04 Press molding
- p Ceramic firing and glazing
- q Composite forming
- r Sewing and leatherwork
- s Fasteners
- t Adhesive joining
- u Surface finishing and surface treatments

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06 Chemical methods

- a Labware
- b Handling chemicals
- c Solvents
- d Preparing solutions
- e Measuring physical properties of liquids and interfaces
- f Purified water and water quality measurement
- g Working with solids
 - 01 Grinding & milling
 - 02 Sieves
- h Working with gases
- i Straining and filtering
- j Centrifugation
- k Cyclone separation
- l Chromatography, liquid chromatography, gas chromatography,
- m Electrophoresis and dielectrophoresis
- n Precipitation, recrystallization
- o Concentration, desiccation and freeze drying
- p Distillation, evaporation, condensation
- q Stirring, agitating, mixing, and blending
- r Homogenization, emulsification, and colloidal dispersion
- s Volumetric analysis and titration
- t Electrochemistry
- u pH (*see 08 Measurement and sensors*)

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07 Energy systems

- a Human and animal power
- b Mechanical energy storage
 - 01 Elastic
 - 02 Elastomer
 - 03 Rotational kinetic (flywheel)
 - 04 Pneumatic
- c Batteries
- d Fuel cells
- e Photovoltaics
- f Direct energy conversion and energy harvesting
 - 01 Thermoelectric
 - 02 Bimetallic strip
- g Small gas-powered generators
- h Regulated power supplies
- i DC-to-AC inverters
- j Inductive and wireless energy transfer
- k Wind generators
- l Hydroelectric generators
- m Wave & tidal energy conversion
- n Solar thermal energy
- o Geothermal energy
- p Microbial energy generation
- q Radioisotope thermal energy generation
- r Fuels
 - 01 Coal
 - 02 Petroleum
 - 03 Hydrogen
 - 04 Biofuel
 - 05 Biomass
- s High power electric power generation plants
- t Nuclear power plants
- u Cogeneration and thermal energy recovery
- v Electric power grid
- w Microgrids and distributed generation

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08 Measurement and sensors

- a Fundamental units and standards
 - 01 Length
 - 02 Mass
 - 03 Time
 - 04 Current
- b Transfer standards and methods
- c Sensor and measurement technologies
 - 01 Mechanical
 - 02 Electrical
 - 03 Semiconductor
 - 04 Microelectromechanical (MEMS)
 - 05 Optical
 - 06 Electrooptical
- d Time and frequency
 - 01 Mechanical clocks
 - 02 Quartz crystal clocks
 - 03 Atomic clocks
 - 04 Use of stopwatches
 - 05 Photogates
 - 06 Magnetic sensor triggers
- e Dimension
 - 01 Tape measures
 - 02 Trundle wheels
 - 03 Rulers
 - 04 Transfer calipers
 - 05 Direct reading calipers
 - .01 Vernier*
 - .02 Dial indicator*
 - .03 Digital*
 - 06 Micrometers
 - .01 Vernier*
 - .02 Digital*
 - 07 Double-thread micrometers
 - 08 Interferometric methods
- f Proximity, range, and level
 - 01 Optical rangers
 - 02 Ultrasound rangers
 - 03 Laser rangers
 - 04 Capacitive level sensors
 - 05 Resistive level sensors
 - 06 Ultrasound level sensors
- g Physical presence
- h Travel distance and position
- i Angles and directions
- j Linear and angular velocity
- k Linear and angular acceleration
- l Strain
 - 01 Resistive strain gauge
 - 02 Photoelastic strain measurement

- m Mass and weight
- n Force
- o Stress and pressure
- p Temperature
 - 01 Liquid-in-glass
 - 02 Thermocouple
 - 03 Thermistor
 - 04 Solid state device
 - 05 Infrared sensor

See also 20 Thermal systems: Low temperature apparatus: Low temperature thermometry
- q Volume
- r Flow
- s Sound
- t Light
 - 01 Radiometric and photometric quantities and definitions
 - 02 Photoresistor
 - 03 Photo diode
 - 04 CCD array
 - 05 Photo cell
 - 06 Photomultiplier tube
 - 07 Avalanche photodiode
- u Infrared thermal
- v Electromagnetic fields

See 39a Electric fields, discharges, and plasmas: electric field measurement
See 40a Magnetic fields and superconductors: magnetic field measurement
- w Chemical sensors
- x Biosensors
- y Physiological sensors
- z Wireless sensor networks
- aa Quantum measurement

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09 Spectroscopic and analytical instrumentation

See also 45 Nanoscale Microscopy and Measurement

See also 47 Molecular Biology Methods

- a Prism and simple grating spectrometers
- b Compact fiber-optic input grating spectrometers
- c Photographic film-based grating spectrographs
- d Grating monochromators
- e Atomic emission spectroscopy
- f Inductively coupled plasma (ICP) atomic emission spectroscopy
- g Atomic fluorescence spectroscopy
- h Laser-induced fluorescence
- i UV-VIS absorption spectroscopy
- j Infrared absorption spectroscopy including FTIR
- k Raman spectroscopy
- l Microwave spectroscopy
- m Vacuum UV spectroscopy
- n X-ray spectroscopy
- o Mossbauer spectroscopy
- p Nuclear magnetic resonance
- q Electron spin resonance
- r Gas chromatography (including GCMS)
- s Liquid chromatography (including HPLC-MS)
- t Electrophoresis
- u Cyclic voltammetry and other electroanalytical methods
- v Differential scanning calorimetry and other thermal methods
- w Mass spectrometry and its variations
- x Ion cyclotron resonance
- y Photoemission spectroscopy
- z Auger spectroscopy
- aa Gravimetric analysis

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10 Structural systems

- a Structural principles and loads on structures
- b Strength of materials and experimental stress analysis
- c Structural elements and their examples in use
 - 01 Beams
 - 02 Columns, struts and posts
 - 03 Ties and cables
 - 04 Plates, floors & tops
 - 05 Walls
- d Structural assemblies & archetypes
 - 01 Arch
 - 02 Shell
 - 03 Frame
 - 04 Truss
 - 05 Space frame
 - 06 Boom
 - 07 Tower
- e Structural materials
- f Structural joints
- g Structural footings and foundations
- h Structural kits and component systems
 - 01 Bar and clamp (as in chemistry labs)
 - 02 Grid-beam
 - 03 Unistrut
 - 04 Dexion
 - 05 80-20
 - 06 Rexroth
- i Structural monitoring and smart structures
- j Structural vibration
- k Structural stability and structural failure
- l Laboratory furniture
 - See 11d Laboratory, workshop and studio furnishings*
- m Storage and shelving
 - See 16 Rigging, materials handling, and storage*
- n Laboratory instrument structures
 - 01 Instrument racks
 - 02 Prefabricated instrument enclosures
 - 03 Custom instrument enclosures
- o Laboratory apparatus structures
- p Machinery structures
- q Remote field instrument enclosures
- r Vacuum and pressure vessels
 - See 21 Vacuum and high pressure*
- s Vehicle structures
 - See 15 Vehicles*
- t Display structures
- u Ladders, scaffolds, and work platforms
- v Platform and ramp construction

- w Scene design and stage construction
- x Lightweight and quickly deployed structures
- y Structures in nature
- z Various special structures
 - 01 Antenna masts
 - 02 Radio telescope dishes

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11 Buildings, labs, and work areas

- a Small building design, construction and maintenance
- b Interior partitions design, construction and maintenance
- c Laboratory, workshop and studio design and layout
- d Laboratory, workshop and studio furnishings
 - 01 Lab benches
 - 02 Laboratory chairs, stools
 - 03 Easels
- e Laboratory, workshop and studio special services
 - See also 01 Safety and hazardous materials***
 - 01 Multiple power outlets
 - 02 Special power (220 volt, 440 volt three-phase)
 - 03 Compressed air
 - 04 Natural gas
 - 05 Vacuum ports
 - 06 Distilled water
 - 07 Special drainage
 - 08 Special lighting
 - 09 Data connections
- f Laboratory, workshop, and studio special environments
 - 01 Dark rooms
 - 02 Clean rooms
 - 03 Shielded rooms
 - 04 Low vibration foundation
 - 05 Equipment drop wells or hoist towers
- g Special buildings
 - 01 Astronomical observatories
 - 02 Greenhouses
- h Building structural elements and their maintenance
 - 01 Foundation
 - 02 Frames
 - 03 Joists
 - 04 Flooring
 - 05 Walls
 - 06 Sealing and insulation
 - 07 Exterior covering
 - 08 Ceilings
 - 09 Roof
 - 10 Roof drainage
 - 11 Doors
 - 12 Windows
 - 13 Stairways
- i Building physics
- j Building systems - electrical layout and fixtures
- k Building systems - plumbing layout and fixtures
- l Building systems - air conditioning
- m Building systems – heating, ventilation and air conditioning (HVAC)
- n Building systems – fireplaces, wood stoves and chimneys
- o Building systems - lighting
- p Building systems - access and security

- q Building systems - fire detection and suppression
- r Universal design for access and mobility
- s Elevators, escalators and moving walkways

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12 Geotechnics, hydraulics, and land use design

- a Soil modeling and modification
 - 01 Soil composition and structure
 - 02 Water transport through soils
 - .01 *Darcy's Law for transport through saturated soils*
- b Rock modeling and modification
- c Water channel modeling and design
- d Shore structures modeling and design
- e Paths, walkways and trails
- f Retaining walls
- g Slope stabilization
- h Trenches
- i Tunnels
- j Embankments
- k Drainage beds & pipes
- l Locating underground utilities
- m Detecting underground objects
 - 01 Ground penetrating radar
 - 02 Underground electric resistance tomography
- n Trees and vegetation

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13 Machines and mechanisms

- a Fundamentals of mechanical force transmission
 - 01 Simple prototypes illustrate force transmission
 - 02 Machine element stress analysis and measurement
- b Friction, tribology and wear
- c Simple machines
- d Machine examples
- e Mechanical model making
- f Kinematic mounts and precision machine design
- g Flexible elements and movable joints
- h Guides and slides
- i Cable and fluid transmissions
- j Shafts, bearings and seals
- k Rotary drives and transmissions
 - 01 Friction drives
 - 02 Belts and pulleys
 - 03 Timing belts and pulleys
 - 04 Chains and sprockets
 - 05 Spur gears
 - 06 Helical gears
 - 07 Bevel gears
 - 08 Worm gears
- l Linear drives and transmissions
 - 01 Rack and pinion
- m Linkages
- n Cams and other complex motion devices
 - 01 Cams
 - 02 Geneva mechanisms
- o Ratchets and escapements
- p Clutches
- q Brakes

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14 Actuators

- a General aspects of actuators
- b Voice coils
- c Solenoids
- d Electric motors
 - 01 DC motors
 - 02 DC servo motors
 - 03 Pulse controlled servos

Includes small servo units typically used in hobby radio controlled vehicles

- 04 Brushless DC motors
- 05 Stepper motors
- 06 Homopolar motors
- 07 Induction motors
- 08 Shaded pole motors
- 09 Three phase synchronous motors
- 10 –
- 11 –
- 12 Dynamometers and motor torque-speed testing
- e Linear motion electric motors
- f Pneumatic actuators
See also 21b Vacuum and high-pressure systems: compressed gas systems
- g Hydraulic actuators
See also 21d Vacuum and high-pressure systems: hydraulic plumbing
- h Shape memory alloys & bimetallic strips
- i Piezoelectric and magnetostrictive actuators
- j Ultrasonic wave motors
- k Spring motors
- l Heat engines
- m Internal combustion engines
- n Turbines
- o Electric ducted fans
- p Hydrogels and polymer actuators
- q Ferrofluids and electrorheological fluids
- r Ballistic devices – ancient
- s Ballistic devices – firearms
- t Ballistic devices – advanced
 - 01 Aircraft carrier launchers
 - 02 Railguns
- u Rockets
- v Explosives
- w Brakes
See 13q Machines and mechanisms: brakes

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15 Vehicles

- a Land vehicle elements
 - 01 Frame structure
 - 02 Body structure (if applicable)
 - 03 Managing air resistance
 - 04 Energy supply
 - 05 Power plant
 - 06 Torque conversion
 - 07 Transmission
 - 08 Axles and bearings
 - 09 Suspension
 - 10 Wheels
 - 11 Ground traction
 - 12 Steering
 - 13 Vehicle dynamics
 - 14 Sensing and control
 - 15 Stabilization
 - 16 Vibration and noise control
 - 17 Impact mitigation
- b Water vehicle elements
 - 01 Hull structure
 - 02 Buoyancy
 - 03 Deck and super structure (if applicable)
 - 04 Managing drag, wake and turbulence
 - 05 Energy supply
 - 06 Power plant
 - 07 Propeller or other thrust generator
 - 08 Sails (if applicable)
 - 09 Steering
 - 10 Sensing and control
 - 11 Vehicle dynamics
 - 12 Stabilization
 - 13 Wave response and sea keeping control
 - 14 Vibration and noise control
 - 15 Impact mitigation
- c Air vehicle elements
 - 01 Fuselage structure
 - 02 Wing structure
 - 03 Lift
 - 04 Managing drag, wake and turbulence
 - 05 Energy supply
 - 06 Power plant
 - 07 Thrust generator
 - 08 Takeoff assist (if applicable)
 - 09 Takeoff and landing gear
 - 10 Steering
 - 11 Sensing and control
 - 12 Attitude control
 - 13 Vehicle dynamics
 - 14 Stabilization
 - 15 Vibration and noise control
 - 16 Impact mitigation

- d Rocket and space vehicle elements
 - 01 Launch vehicle structure
 - 02 Cabin or instrument enclosure structure
 - 03 Energy supply
 - 04 Thrust
 - 05 Trajectory
 - 06 Attitude control
 - 07 Orbit dynamics
 - 08 Managing drag
 - 09 Sensing and control
 - 10 Stabilization
 - 11 Vibration and noise control
 - 12 Impact mitigation
 - 13 Vehicle return
- e Specific application areas of vehicle design and operation
 - 01 Skates, scooters and self-balancing personal transporters
 - 02 Bicycles and electric bicycles
 - 03 Mopeds and motorcycles
 - 04 Non-motorized carts and land conveyances
 - 05 Small motorized carts, utility vehicles, and all-terrain vehicles
 - 06 Farm vehicles and small mobile machinery
 - 07 Automobiles
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 - 10 Warehouse and retail inventory management
 - 11 Automobile tracking and emergency response systems
 - 12 Personal mobility device tracking
 - 13 Hospital systems monitoring
 - 14 Patient monitoring
 - 15 Patient medical device monitoring
 - 16 People tracking
 - 17 Pet tracking
 - 18 Wildlife tracking
 - 19 Smart homes
 - 20 Smart farms
 - 21 Equipment maintenance monitoring
 - 22 Smart grids
 - 23 Smart infrastructure e.g. bridges

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36 Optics and optical systems

- a Light sources
 - b Optical properties of materials
 - c Optical elements selection and specification
 - d Infrared, UV and X-ray optics
 - e Polarizers and polarization phenomena
 - f Diffraction-based components
 - g Fourier optics
 - h Optics fabrication
 - i Optics testing
 - j Optics cleaning and maintenance
 - k Optical aberrations and their control
 - l Optical design software
 - m Design of compound optical systems
 - n Optical mounts and opto-mechanical design
 - o Optics tables and support structures
 - p Fiber optics
 - q Interferometry
 - r Optical instruments
 - 01 Autocollimators
 - s Adaptive optics
 - t Non-imaging optics
- See 44 Thin films, microfabrication and microdevices*

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37 Lasers and photonics

- a Optical cavities
- b Gas lasers
- c Diode lasers – semiconductor lasers
- d Tunable diode lasers
- e Solid state lasers
- f Fiber lasers
- g Photonic crystal lasers
- h Dye lasers
- i Excimer lasers
- j Free-electron lasers
- k Laser pulsing methods
- l Pico-second lasers
- m Femto-second lasers
- n Laser alignment
- o Working with invisible radiation
- p Acousto-optic devices
- q Electro-optic materials
- r Kerr cells
- s Pockels cells
- t Nonlinear optics
- u Masers

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38 Imaging and remote sensing

- a Electronic sensor arrays
 - 01 CCD
 - 02 CMOS
 - 03 Photodiode
- b Sensor cooling
- c Photographic film
- d Densitometry
- e Photographic lighting
- f Pinhole cameras
- g Projective geometry
- h Human eye optics
- i Simple lens cameras
- j Multi-element lenses
- k Telephoto lenses
- l Telescopes
- m Zoom lenses
- n Macro lenses
- o Manual and automatic focusing technologies
- p Manual and automatic exposure control technologies
- q Computer and mobile device built-in cameras
- r Web cameras
- s Point-and-shoot digital cameras
- t Large format view cameras
- u Single-lens reflex cameras
- v Mirrorless cameras
- w Camera mounts
- x Camera and lens cases
- y Image compression and image file formats
- z Digital image processing
- aa Analog video signals and standards
- bb Digital video formats
- cc Moving film cameras
- dd Image triggering and synchronization
- ee Time-lapse imaging
- ff High speed photography
- gg High speed video
- hh Low light and high dynamic range imaging
- ii Non-visible imaging
- jj Special effects imaging
- kk Holography
- ll Drone-based imaging
- mm Underwater imaging
- nn Equipment photography and photo-documentation
- oo Nature photography

- pp Binoculars and spotting telescopes
- qq Sighting, alignment, and utility telescopes
- rr Refracting telescopes
- ss Reflecting telescopes 250 mm diameter
- tt Large reflecting telescopes
- uu Telescope mounts and drives
- vv Photogrammetry
- ww Multi-spectral imaging for remote sensing

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39 Electric fields and plasmas

- a Electric field measurement
- b Material behavior in strong electric fields
- c Electrostatic generators
 - 01 Triboelectric generation
 - 02 Piezoelectric generation
 - 03 Wimshurst machines
 - 04 Van de Graaf generators
- d Tesla coils
- e High voltage transformers
- f High voltage power supplies
- g High voltage insulators and mounts
- h High voltage cables
- i High voltage switching
- j High voltage regulation
- k DC gas discharge tubes
- l DC arcs
- m Lightning observation and measurement
- n Lightning protection
- o Low frequency AC gas discharge tubes
 - 01 Neon indicator lamps
 - 02 Fluorescent lamp fixtures
 - 03 Neon lighting
- p Capacitively coupled RF plasma generation
- q Inductively coupled RF plasma generation
- r Microwave plasmas
- s Flow – plasma interaction
- t Plasma heating
 - 01 Electron cyclotron resonance heating
- u Toroidal plasma containment
- v Other types of plasma containment

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40 Magnetic fields and superconductors

- a Magnetic field measurement
- b Magnetic properties of materials
- c Magnetic susceptometry
- d Dynamic effects and dissipation in magnetic materials
- e Magnet balances
- f Helmholtz coils
- g Air solenoids
- h Permanent magnets
- i Conventional solenoid electromagnets
- j Conventional poled electromagnets
- k Conventional electromagnet power supplies
- l Magnet shimming
- m Magnetic field gradient generation
- n Magnet cooling
- o High T-c superconductor magnets
- p Low temperature superconductor magnets
- q Superconducting magnet power supplies
- r High-Tc superconductor fabrication and testing
- s High-Tc superconductor applications
- t Low temperature superconductor applications
- u Josephson junctions
- v SQUIDs
- w SQUID magnetometry
- x Other superconducting devices
- y Magnetic levitation

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41 Charged-particle optics and instruments

- a Charged particle sources
- b Charged particle traps
 - 01 Paul trap
 - 02 Penning trap
 - 03 Magneto-optical trap
- c Acceleration electrodes
- d Lenses
- e Deflectors
- f Phosphors
- g Faraday cups
- h Beam dumps

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42 Nuclear and elementary particle methods

- a General aspects of nuclear and elementary particle systems
- b Radioactive sources
- c Accelerators
- d Storage rings
- e Relativistic particle beams
- f Detectors
 - 01 Geiger tubes
 - 02 Scintillators
 - .01 Sodium iodide*
 - .02 Plastic*
 - .03 Fiber*
 - 03 Lithium-drifted germanium
 - 04 Transition edge detectors
- g Nuclear instrumentation
 - 01 Pulse preamps
 - 02 Pulse shapers
 - 03 Pulse height discriminators - Single channel analyzers
 - 04 Scaler – counters
 - 05 Fast analog-to-digital conversion
 - 06 Multichannel analyzers
 - 07 Coincidence detectors
 - 08 Time-to-pulse-height converters

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43 Microscopy and micromanipulation

- a Simple lens magnification
- b Inspection microscopes
- c Optical comparators
- d Optical illumination methods
 - 01 Koehler illumination
- e Light field optical microscopy
- f Dark field optical microscopy
- g Optical polarization microscopy
- h Fluorescence microscopy
- i Light sheet fluorescence microscopy
- j Two-photon fluorescence microscopy
- k Total internal reflection fluorescence microscopy
- l Confocal microscopy
- m Fluorescence correlation microscopy
- n Ultra-resolution optical microscopy
 - 01 StED
- o Single-molecule microscopy
- p Microscope stages
- q Specimen environment control
 - 01 Temperature
 - 02 Atmosphere composition
- r Micro-translators
- s Micropipettes
- t Laser tweezers

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44 Thin films, microfabrication, and microdevices

- a Physical vapor deposition
- b Chemical vapor deposition
- c Molecular-beam epitaxy
- d Photolithography
 - 01 Photomask generation
 - 02 Mask aligners
 - 03 Etching methods
- e e-beam lithography
- f Wire bonding
- g Thin-film optics and ellipsometry
- h Microfluidics
- i Micro-electro-mechanical machines (MEMs)
- j Micro-optics and integrated optics

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45 Nanoscale microscopy and measurement

- a Scanning tunneling microscope
- b Atomic force microscope
- c Magnetic force microscope
- d Near field scanned optical microscopy
- e Scanning electron microscope
- f Transmission electron microscope
- g X-ray diffraction
- h Electron diffraction
- i Neutron diffraction

See also ultra-resolution optical microscopy

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46 Nanotechnology and atom manipulation

- a Nanolithography
 - 01 E-beam lithography
 - 02 Molecular beam
- b Nanoparticles
 - 01 Gold nanospheres
 - 02 Quantum dots
 - 03 Fullerenes
 - 04 Carbon nanotubes
- c Self-assembly techniques
 - 01 Surface functionalization
 - 02 Self-assembled monolayer
 - 03 Supramolecular assembly
- d Nanotribology
- e Nanoscale fluid mechanics
- f Molecular electronics
- g AFM-based atom positioning
- h Biological nanomachines
 - 01 Molecular rotors
 - 02 Flagella
 - 03 Microtubule transporters
 - 04 Ribosome guided transcription
- i Synthetic nanomachines

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47 Molecular biology methods

This is just a beginning list

- a Plasmid alteration and replication
- b DNA extraction
- c RNA extraction
- d Protein crystallization
- e Polymerase chain reaction (PCR) amplification
- f CRISPR – Cas9 gene editing
- g Fluorophore attachment
- h Radiolabeling
- i Gel electrophoresis
- j Northern and Southern blots

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48 Cell and microbiology methods

This is just a beginning list

- a Sterile technique
- b Laminar flow hoods
- c Cell culture
 - 01 Bacteria
 - 02 Algae
 - 03 Plant cell
 - 04 Animal cell
- d Cell counting
- e Cell flow cytometry
- f Micropipette techniques
- g Voltage-clamp methods for membrane ion conductance
- h Membrane electroporation

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49 Plant and animal biology methods

This is just a beginning list

- a Plant illumination
- b Plant growth chambers
- c Standards for animal care
- d Animal feeders
- e Animal respirators
- f Animal anesthesia
- g Dissection
- h Tissue preservation

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50 Biomedical devices, instrumentation, and imaging

This is far from complete.

- a Personal monitoring devices
 - 01 Temperature
 - 02 Pulse rate
 - 03 Step counting
 - 04 Weight
 - 05 Blood pressure
 - 06 PO₂
 - 07 Blood glucose
- b Basic examination instruments
 - 01 Stethoscope
 - 02 Otoscope (ear)
 - 03 Ophthalmoscope (eye)
 - 04 Throat
 - 05 Reflex
- c Clinical laboratory measurements
- d Electrical monitoring
 - 01 EKG
 - 02 EMG
 - 03 EKG
- e Breathing measurements
 - 01 Breathing rate
 - 02 Spirometry
 - 03 Capnography
- f Anesthesia
- g Resuscitation and life support
 - 01 Defibrillators
 - 02 Respirators
 - 03 Heart-lung machine
 - 04 Dialysis
- h Wearable or Implanted devices
 - 01 Pacemaker
 - 02 Implantable cardioverter-defibrillator
 - 03 Cochlear implant
 - 04 Insulin pump
- i Basic assistive devices
 - 01 Eyeglasses
 - 02 Hearing aids
- j Prosthetic devices
- k Thermal-based therapies
- l Radiation therapies
 - 01 Radiation treatment of cancer
 - 02 Proton therapy
 - 03 Gamma knife
- m Ultrasound imaging
- n Ultrasound blood flow measurement
- o X-Ray radiography
- p X-ray computer aided tomography

- q Magnetic resonance imaging (MRI)
- r Functional MRI
- s Positron emission tomography
- t Optical coherence tomography

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51 Fieldwork and outdoor skills

- a Navigation
 - 01 GPS
 - 02 Maps
 - 03 Compass
 - 04 Sextant
 - 05 Orienteering
- b Surveying
- c Outdoor clothing
- d Backpacks
- e Sleeping gear
- f Tents and other shelters
- g Cook gear
- h Food preservation and storage
- i Fire making
- j Portable lighting
- k Water supply
- l Waste management
- m First aid and field medicine
See 01b Safety and Hazardous Materials: First Aid
- n Hazardous plants and animals
- o Injured person transport and extraction
- p Rope work and climbing gear
- q Field tools
 - 01 Multipurpose knife
 - 02 Saw
 - 03 Ax
 - 04 Shovel
 - 05 Trowel
 - 06 Brush
 - 07 Tape measure
 - 08 Duct tape
 - 09 Repair kits
- r Field notes
- s Instrument cases
- t Specimen containers and transport
- u Power for field instruments
- v Field-hardened computers
- w Location marking signs and tapes
- x Radio and other communications
- y Field workspace structures
- z Field monitoring station design and construction
- aa Supply logistics
 - 01 Human transport
 - 02 Animal transport
 - 03 Air drop
 - 04 Food

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52 Extreme environments and space

This is just a beginning list

- a Extreme environment types
 - 01 Desert
 - 02 High mountain
 - 03 Active volcano
 - 04 Deep caves
 - 05 Tropical rain forest
 - 06 Polar regions
 - 07 Open ocean
 - 08 Underwater
 - .01 Upper ocean
 - .02 Deep sea
 - 09 High acceleration
 - 10 Space
 - 11 Earth's moon
 - 12 Planets and their moons
 - 13 Burning building or forest
 - 14 War zone
 - 15 Biological infection hot zone
 - 16 Reactor accident sites
- b Protective clothing
 - 01 Clothing for extreme cold
 - 02 Heat resistant suits
 - 03 Biohazard suits
 - 04 Radiation protection suits
 - 05 g-Suits
 - 06 SCUBA diving gear
 - 07 Spacesuits
- c Behavior of materials in extreme environments
- d Operation of machines in extreme environments
- e Microgravity simulation
 - 01 Drop towers
 - 02 Aircraft free fall trajectories
 - 03 Sounding rocket free fall trajectories
- f Uses of microgravity

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