

## GLOSSARY

- Absorption Spectrum:* The spectrum created when radiation is filtered through a medium.
- Acceptance Angle:* The maximum for light acceptance by an optical element. Also referred to as the acceptance cone.
- Accommodation:* The ability to change the focus of the eye by changing the shape of the lens.
- Adaptive Optics:* Deformable mirrors that compensate for changes in an optical system or atmospheric conditions that cause blurring of images.
- Add/Drop Multiplexer:* A device used to both extract and reintroduce specific wavelengths into a WDM system.
- Airy Disc:* The central bright region of the diffraction pattern that results from light passing through a small circular hole.
- Amplitude (A):* The maximum displacement of the wave from the level of the undisturbed medium.
- Amplitude Division:* An interferometer that divides the amplitude of an incoming beam of light with a device such as a beam splitter.
- Angular Frequency:* A measure of rotation rate defined by  $2\pi$  times the frequency.
- Angular Magnification (Magnifying Power):* The ratio of the apparent angular size of an image when viewed through an optical device to the apparent angular size of the object when observed by the unaided eye.
- Anisotropic:* A quantity that changes according to orientation.
- Anti-Reflection Coatings:* A thin film coating used to reduce light loss due to reflection.
- Antinode:* Halfway between any two nodes in a standing wave, the place in the standing wave pattern where the amplitude is a maximum.
- Astigmatism:* 1) Irregularities in the cornea of the eye that cause vision to be blurred in one direction only.  
2) A third order aberration causing an off axis point to be imaged as lines in two planes.
- Atomic Force Microscope (AFM):* A microscope that produces a three-dimensional image of a sample's surface by moving a tiny probe across the surface.
- Attenuation:* Loss of light as it passes through an optical device such as a fiber.
- Autofocus:* An active or passive system used to focus a camera automatically.
- Avalanche Photodiode (APD):* A device that uses avalanche multiplication of photocurrent to achieve amplification.
- Back Reflection:* Light reflected backwards in an optical system, opposite the intended direction of travel of light.
- Ballast resistor:* A large resistor used to limit current in a plasma tube.
- Bandwidth:* Range of frequencies that comprise a signal.
- Beam splitter:* A device used to divide one beam into two beams of lesser amplitude.
- Biophotonics:* The application of photonics to bioscience.
- Birefringence:* Having two indices of refraction for different polarizations.
- Blackbody:* An object that absorbs all incident light at every wavelength so it appears black to the eye.
- Blink Reflex:* See *Human Aversion Reaction Time*.
- Brewster Window:* A plate of glass positioned at Brewster's angle to produce polarized light.
- Brewster's Angle:* The angle of incidence at which the reflected light is completely polarized perpendicular to the plane of incidence.
- Cassegrain Telescopes:* Use a convex mirror to direct the light from the primary mirror back through an opening in the primary.
- Central Ray:* In ray tracking, the ray that heads from the tip of the object to the center of the lens and passes to the image without deviation.

*Charge Coupled Devices (CCD)*: A semiconductor imaging device that uses metal-oxide semiconductor technology.

*Chemiluminescence (Bioluminescence)*: A chemical reaction in which light is produced.

*Chromatic Aberration*: Aberration resulting from the dependence of index of refraction on wavelength.

*Chromogen*: A strongly pigmented or pigment producing organism.

*Circularly Polarized Light*: The electric field vector sweeps out a circle during each cycle of the wave as the wave propagates forward.

*Circulator*: A one-way device similar to a traffic circle used in fiber optic systems to route specific wavelengths along different paths.

*Cladding*: A material with low refractive index that surrounds the core of an optical fiber in order to contain core light and protect against contamination.

*Clear Aperture (CA)*: The opening in the mount of an optical system that restricts the rays incident on a given surface. Also called a free aperture or objective aperture.

*Coherence Length*: See *Longitudinal Coherence Length*.

*Color Rendering Index (CRI)*: Describes how different color surfaces look when illuminated by a source of light.

*Color Temperature*: Is used to compare the overall color of light sources.

*Complementary Metal Oxide Semiconductor (CMOS)* A widely used type of semiconductor technology for integrated circuits with low noise and power consumption.

*Cones*: Sensors in the retina used for high resolution vision, such as reading, and for color vision.

*Confocal Microscope*: A microscope that has apertures in conjugate plane positions inside the microscope, with one in front of the illumination source and the other in front of the detector.

*Conjugate Points*: The two points on a principal axis such that light emitted at either point is focused at the other.

*Constructive Interference*: Interference pattern caused by two waves in phase. The amplitude of the resulting wave is equal to the sum of the amplitudes of the original waves.

*Converging Lens (Positive lens)*: A lens that directs all of the incoming parallel rays to a focal point.

*Continuous Wave (CW)*: A laser that is continuously on with roughly constant power.

*Core*: The inner portion of an optical fiber that conducts light.

*Critical Angle*: When the angle of incidence is such that the refracted angle is 90 degrees.

*Crosstalk*: The extent to which a signal transmitted on one input creates an undesired effect in another input or channel.

*Cutoff Wavelength*: 1) In fiber optics, the shortest wavelength at which a fiber transmits in single mode. 2) In filter terminology, the wavelength at which filter transmission falls below 5 percent.

*Cytometry*: The measurement of cells.

*Dark Current Noise*: Refers to the amount of current generated by a detector when no light is applied.

*Data Compression*: Removes redundant data from images.

*Depletion Region*: pn junction where there are no free charge carriers.

*Depth of Focus (DOF)*: The distance over which the focal spot of a lens is approximately constant.

*Destructive Interference*: Interference that decreases the resultant signal because the component waves are out of phase with each other.

*Dichroic Mirror*: A thin film filter tuned to reflect only one wavelength in a beam of light while transmitting the remaining wavelengths.

*Dielectric*: A material that is a poor conductor of electricity, e.g., glass.

*Diffraction*: The bending of light around the edges of an object.

*Diffraction Grating*: A device consisting of hundreds or even thousands of closely spaced slits.

*Diffraction Limited Spot Size*: The size of a focused spot in an optical system that is otherwise “perfect” except for diffraction effects.

*Dipole Radiation:* An electric dipole is a positive and negative charge separated by a small distance. When the charges oscillate, dipole radiation is produced.

*Direct Sensing:* The direct conversion of optical pulses into electrical signals.

*Disc Calorimeters:* Devices used for power and energy measurement through the sensing of heat.

*Dischromated Gelatin:* Photographic emulsion used to produce extremely bright holograms.

*Dispersion:* The index of refraction depends on wavelength.

*Dispersion Compensation:* Techniques used in optical fiber systems to overcome pulse spreading due to dispersion.

*Distributive Feedback (DFB):* A diode laser with internal corrugated structures that result in single mode operation.

*Diverging Lens (Negative Lens):* A lens that directs all the incoming parallel rays and diverges them, spreading the rays out. The focal length is negative.

*Ductility:* The degree to which a material will deform plastically before fracturing.

*Dynodes:* A photomultiplier electrode that causes secondary electron emission and amplification.

*Electron-Volt (eV):* The energy gained by one electron when it is accelerated through a potential difference of 1 volt; a unit of measurement for very small energies.

*Elliptical Polarization:* The most general form of polarization where the electric field changes amplitude as it rotates, tracing out an ellipse.

*Embedded Laser Systems:* Laser systems that do not allow access to the beam while in operation.

*Emission Lines:* Narrow wavelength emission by a low pressure gas when excited electrons return to lower energy levels.

*Energy Pump:* The source of energy for a laser.

*Erbium-Doped Fiber Amplifiers (EDFA):* Fibers based amplifiers for optical inputs.

*Etalon:* A Fabry-Perot interferometer used as a very sharp wavelength filter.

*Excess Power Loss:* Describes the power that is lost in a star coupler from a variety of effects.

*Excited States:* Energy levels at higher energy than the ground state.

*Extraordinary Light:* In a birefringent materials, one of the two oppositely polarized rays of light existing inside the crystal. Its velocity varies with direction inside the crystal.

*Extrinsic Losses:* Losses caused by physical connections made when coupling light in and out of a fiber and when connecting segments of fiber together using connectors and/or splices.

*Eye Lens:* For a simple two-lens telescope, the lens nearer the eye.

*Eyepiece:* A lens system used between the real image and the observer's eye that acts as an image magnifier.

*Fabry-Perot Laser:* A laser oscillator using two mirrors. Usually refers to multi-wavelength mode diode lasers.

*Fixer:* Chemical treatment during photographic development to prevent further chemical change of the film.

*Fluorescence:* A process in which an atom is excited into one of its short lifetime excited states and then spontaneously returns to the ground state by emitting one or more lower energy photons.

*Focal Point:* The converging point of parallel incident light rays on the optical axis of a thin lens.

*Focal Ray:* In ray tracing, enters the lens after passing through the focal point on the left hand side of the lens and exits the lens traveling parallel to the optical axis.

*Forward Bias:* Electrons are injected into the n-side of a pn junction.

*Fovea Centralis:* A small region on the retina with maximum resolution responsible for sharpest vision.

*Fraunhofer or Far-Field Diffraction Pattern:* A diffraction pattern observed at an infinite distance from the source.

*Frequency (f):* The number of oscillation cycles that take place in a given time, usually one second.

*Fresnel or Near-Field Diffraction Pattern:* A diffraction pattern observed close to an aperture.

Glossary from [LIGHT - Introduction to Optics and Photonics](#) by Judith Donnelly and Nicholas Massa.

Available through <http://www.photonprojects.org>.

*Fresnel Reflection Equations*: Predict the percent of light reflected from a surface as a function of the incident angle and direction of incident light polarization.

*Fringe*: Dark and bright spots or bands in an interference pattern.

*Frustrated Total Internal Reflection (FTIR)*: When total internal reflection is prevented by surface contact with another medium.

*Gabor Zone Plate*: A type of zone plate (system of concentric rings) where the transmission of the zones varies across the plate.

*Gain Medium*: A laser medium capable of supporting a population inversion.

*Geometric Optics*: Deals with light as if it were a ray that travels in straight lines unless deflected by an obstacle.

*Graded Index Fiber*: A fiber that has a core refractive index that decreases radially outward toward the cladding.

*Graybody*: Radiates energy with a blackbody distribution but reduced by a constant factor.

*Ground State*: The minimum energy level for an atom.

*Haidinger's Brush*: A faint pattern, usually yellow, visible in polarized light by trained viewers.

*Half Wave Plate*: A plate that rotates the plane of polarization of a light beam by retarding one polarization component by  $180^\circ$ .

*Hardness*: Refers to the resistance of a material to plastic deformation.

*Harmonic Wave*: A wave that is defined by a sine or cosine function.

*Heterojunction Laser*: A laser diode whose junction has been designed to reduce losses in the optical cavity by using dissimilar semiconductors

*Holographic Gratings*: A diffraction grating created by a holographic process.

*Homojunction Laser*: Only one type of semiconductor material is used for the entire structure.

*Horizontal Polarization*: The electric field vibrates horizontally as the wave moves forward.

*Human Aversion Reaction Time (Blink Reflex)*: Average time before a person will blink or turn away from a brilliant source of light (0.25 second).

*Huygens-Fresnel Principle*: Each point on an advancing wave front is the source of a new wave of the same wavelength.

*Hyperopia*: Farsightedness. A vision defect that occurs when the image of a distant object is focused beyond the retina.

*Image Distance*: The distance from a lens or mirror to the image.

*In vitro*: Procedure performed in a controlled environment, not on a live specimen.

*In vivo*: Procedure performed on a live organism such as animal testing or clinical trials.

*Incident Ray*: The ray that strikes a surface.

*Inclusions*: Impurities in the form of contaminant particles.

*Index of Refraction*: The ratio of the speed of light in a vacuum to the speed of light in the material.

*Insertion Loss*: The overall loss incurred when a device such as an optical amplifier, coupler, modulator, or any other component is placed into a fiber optic system.

*Intensity*: In wave theory, it is the square of the wave amplitude. In acoustics, it is the power per unit area. In radiometry, intensity is the power emitted by a point source into a cone of a given solid angle.

*Intermodulation Noise*: Optical noise in a hologram caused by light interference of light originating at different locations on the object.

*Intrabeam Viewing*: Looking directly into a beam.

*Ionization Energy*: The amount of energy needed to free an electron originally in the ground state.

*Iris*: The colored part of the eye that controls the amount of light that enters by varying the size of the pupil.

*Irradiance*: Power density, that is, power per unit area.

*Isotropic*: Having the same properties in every direction.

*Johnson Noise*: See *Thermal Noise*

*Keratectomy*: Removal of part of the cornea to correct refractive defects of the eye.

*Keratotomy*: Surgical incisions in the cornea

*Laser Generated Air Contaminants*: Result from the interaction of high-energy laser radiation, assist gasses used in material processing, and the material itself.

*LASIK*: A type of corneal sculpting used to correct vision problems.

*Latent Image*: The pattern of microscopic changes in a photographic emulsion that will form an image when the emulsion is developed.

*Lateral Coherence*: See *Spatial Coherence*

*LIDAR*: Light Detection and Ranging. A method of remote sensing used to collect topographic information.

*Linearly Polarized Light*: See *Plane Polarized Light*

*Lithography*: The etching of integrated microelectronics (originally, a printing method on flat surfaces).

*Longitudinal Coherence*: Refers to the correlation in phase between points along the direction of propagation.

*Longitudinal Coherence Length*: A measure of the temporal coherence of a laser beam, the distance along the beam over which the laser light has sufficient coherence to produce visible interference fringes.

*Magnetic Force Microscope (MFM)*: A microscope that operates by scanning a probe over an object and detecting the forces exerted on the probe by the object's magnetic fields.

*Magnifying Power*: See *Angular Magnification*

*Malus' Law*: The relationship between the irradiance of the incident and transmitted light for a polarizing material.

*Material Loss*: Absorption by a material due to light interacting with the molecular structure of the material and impurities in the material.

*Maximum Permissible Exposure (MPE)*: The level of laser radiation to which a person may be exposed without hazardous effect to the eye or skin.

*Modal Distortion*: Pulse spreading due to the presence of different modes in an optical fiber.

*Mode Spacing*: The frequency difference between two adjacent laser wavelength modes.

*Myopia*: Nearsightedness, due to the image forming in front of the retina.

*n-Type Semiconductor*: Semiconductor material doped with a material that provides free electrons.

*Natural Light*: See *Randomly Polarized Light*

*Near Point*: The eye cannot focus objects any closer than this distance without assistance.

*Negative Lens*: See *Diverging Lens*

*Newtonian Telescope*: A simple reflecting telescope. The objective is a concave mirror.

*Noise*: Any unwanted fluctuations in a detector's output that interferes with the signal being detected and as such can seriously degrade a detector's performance.

*Nominal Hazard Zone (NHZ)*: An area of potentially hazardous laser radiation.

*Normal Line*: The line that forms a right angle with a flat surface.

*Normalized Frequency, V-number*: A quantity used to characterize optical fiber, based on the operating wavelength, numerical aperture and core diameter. The number of modes depends on V-number.

*Nyquist Noise*: See *Thermal Noise*

*Object Beam*: The light that reflects from the object being recorded in a hologram.

*Object Distance*: The distance from the lens or mirror to the object.

*Objective Lens*: The lens facing the object in a microscope or telescope.

*Optic Axis*: The direction in a doubly refracting material such as calcite where the ordinary and extraordinary rays travel at the same speed.

*Optic Nerve*: Routes signals from the retina to the brain.

*Optical Axis*: A line passing through the centers of the elements of an optical system.

*Optical Cavity*: A volume in which light can set up standing waves modes with low loss.

*Optical Coherence Tomography*: A medical diagnosis technique using light to make high quality, high resolution three dimensional images.

*Optical Density (OD)*: The absorption capability of a material. OD is a function of wavelength.

*Optical Loss Test Kit*: Consists of an optical source and power meter for testing optical fiber.

*Optical Spectrum*: Includes visible light and portions of the UV and IR regions.

*Optical Time Domain Reflectometer (OTDR)*: An instrument that sends narrow pulses of light down to a fiber and measures the amount of time needed for the reflected pulses to return. Used to test fiber optic links for attenuation and breaks.

*Optical Tweezers*: Tools that use a laser beam, or multiple laser beams, to manipulate biological cells and other microscopic matter.

*Optical Waveguide*: A structure with the ability to guide the flow of light.

*Ordinary Light*: In certain birefringent materials such as calcite, the ray that has constant velocity in all directions in the crystal.

*Output Coupler*: A partially reflective mirror at the end of a laser cavity that allows part of the light energy to escape and form the external laser beam.

*pn Junction*: In a semiconductor, the boundary between p-type and n-type materials.

*Parallax*: An optical phenomenon that causes apparent relative motion between objects when the eye is moved laterally.

*Parallel Ray*: Enters the lens traveling parallel to the optical axis. It leaves the lens and passes through the focal point on the right hand side.

*Paraxial Approximation*: In this approximation, only rays near the optical axis are considered so that rays strike the optic at a small angle and the small angle approximation can be used.

*Path Length Difference*: The difference in optical path for two different physical paths followed by a beam that has been divided into two or more parts. It depends both on the physical path lengths and the index of refraction encountered by each beam.

*Penetration Depth*: The thickness of tissue that is numerically equal to the reciprocal of the absorption coefficient.

*Penumbra*: The partially darkened outer shadow of an opaque object that blocks an extended beam of light.

*Period (T)*: The time it takes for the wave (or other harmonic vibration) to repeat itself.

*Phonon*: A quantum of thermal energy or vibration of a crystal lattice.

*Phosphorescence*: Phosphorescent materials have a long lifetime excited state that allows them to continue to glow for a time after the excitation source is removed.

*Photoconductive Device*: The conductivity of the device increases when exposed to light energy.

*Photodynamic Therapy (PDT)*: A photosensitive drug is administered to absorb incident light.

*Photofluorescence*: A research and diagnostic tool that uses a light sensitive drug to reveal tissue abnormalities.

*Photomechanical Processes*: A very short, energetic pulse of light causes tissue to expand with a miniature explosion.

*Photomedicine*: The use of light to improve health.

*Photometric*: Measurements that apply only to visible light and are dependent on the color response of the human eye.

*Photon*: The smallest division of a light beam that retains properties of the beam such as frequency, wavelength, and energy.

*Phototherapy*: The use of light to treat a variety of conditions.

*Photothermal Interaction:* Heating caused by light.

*Photovoltaic Effect:* The release of electrons from a material in response to the absorption of a photon.

*Pile of Plates Polarizer:* A type of polarizing element that relies on the reflection at Brewster's angle from a stack of dielectric plates.

*Plane of Incidence:* The plane containing the incident and reflected rays and the normal to the surface.

*Plane Polarized Light (Linearly Polarized Light):* Has an electric field that oscillates in a specific plane perpendicular to the direction of propagation.

*Plasma:* A hot gas of ionized particles.

*Point Source:* A very small source of light., theoretically a mathematical point, that produces light waves that travel outward in expanding spherical shells.

*Polarization:* Describes the orientation of a light wave's electric field in space.

*Polarization Axis (Transmission Axis):* Electromagnetic fields aligned with a polarizing filter's polarization axis pass through the filter; fields normal to the axis are blocked.

*Population Inversion:* More atoms or molecules in an upper energy state than in a lower energy state.

*Porro Prism:* Two right angle prisms cemented at their long faces at right angles to each other.

*Positive Lens:* A lens with a positive focal length. See *Converging Lens*

*Power Division:* A quantity describing how light is distributed in a fiber optic coupler.

*Power Margin:* The excess power left over after all of the losses in a fiber optic link have been taken into account.

*Presbyopia:* A vision problem due to the inability to accommodate, caused by the aging of the lens and the muscles that support it.

*Propagation Speed:* The speed with which the wave disturbance moves forward in the medium.

*Pupil:* Opening in the eye, its size is controlled by the iris.

*Pyroelectric Detectors:* Use ferroelectric crystals such as lithium tantalate to sense changes in temperature resulting from the absorption of laser radiation.

*Quantum Efficiency:* The ratio of the number of electrons generated by a detector to the number of photons incident on the detector.

*Quantum Noise:* Results from the statistical nature of the generation of electrons.

*Quantum Optics:* Deals with the emission and absorption of light at the atomic or quantum level.

*Quarter Wave Plate:* A piece of birefringent material that retards one component of polarization by  $90^\circ$ .

*Radiationless Transitions:* Transitions from a higher energy state to a lower energy state that do not produce light.

*Radiometric:* Measurements that apply throughout the entire electromagnetic spectrum.

*Randomly Polarized Light (Natural Light):* Light that has no specific orientation of the electric field.

*Ray:* An arrow drawn showing the direction of travel of a wavefront.

*Ray Tracing:* Determining where an image will form by following rays through an optical system.

*Rayleigh Scattering:* Wavelength dependent scattering of light from molecules.

*Rayleigh's Criterion:* A measure of minimum resolution of an optical system when the center of the Airy disk of one source falls on the first minimum of the Airy disk pattern of a second source.

*Real Focus:* Parallel light rays entering a lens or mirror are actually brought to meet at a point in space.

*Real Image:* A projectable image formed when an optical system causes rays from the object to converge to form an image.

*Reference Beam:* In holography, the beam directly from the laser, expanded and used to interfere with the beam reflected from the object.

*Reflection Grating:* Consists of multiple parallel grooves etched into a reflecting surface.

*Reflection Hologram:* Hologram that is viewed with the light source on the same side as the viewer, and the light reflected from the hologram forms the virtual image.

*Reflectivity*: The fraction of the incident light reflected by a surface.

*Refraction*: The bending of light when it goes from one medium to another with a different index of refraction.

*Resolution*: The ability of an optical system to display details in an image.

*Resonant Excitation*: The process of pumping the active energy laser gas indirectly by the transfer of energy via collisions with another excited gas.

*Resolvance*: See *Resolving Power*

*Resolving Power (Resolvance)*: Used to describe the performance of an instrument used to separate light into its spectral components.

*Resonator*: See *Optical Cavity*

*Responsivity*: The ratio of the electrical current generated by a detector to the optical input power.

*Retina*: The light sensitive tissue lining the back of the eye containing the rod and cone cells.

*Rods*: Retinal sensors responsible for low-light viewing. They are not sensitive to color.

*Sag*: The distance a curved surface deviates from flat over its diameter or clear aperture. (

*Scattering Loss*: Due to light scattered by the molecules of the material by structural imperfections and impurities

*Semiconductor*: A material with electrical conductivity between that of a conductor and an insulator.

*Shot Noise*: The noise generated by the random variation in the number and velocity of the electrons generated by a detector.

*Single Frequency Laser Diodes*: Diode lasers constructed to provide feedback at only one wavelength, resulting in a very narrow bandwidth output.

*Single Lens Reflex (SLR)*: Refers to the camera design which features a mirror that directs light from the main lens to a prism, and then to the viewfinder, allowing the photographer to see exactly what will be exposed on the film.

*Signal-to-Noise Ratio*: The ratio of the signal power to the noise power.

*Small Angle Approximation*: When an angle is very small, the sine, the tangent and the angle (in radians) are approximately equal.

*Snell's Law*: The mathematical relationship describing the refracted angle when the incident angle and two indices of refraction are known.

*Solar Constant*: The total amount of solar irradiance reaching the top of the atmosphere at the average earth-sun distance.

*Solid Angle*: A three-dimensional analog to the more familiar plane angle.

*Spatial Coherence (Lateral Coherence)*: Refers to the phase correlation between points on a wavefront, perpendicular to the direction of propagation.

*Spatial Coherence Length*: The distance between two points on the wavefront where the wave is spatially coherent.

*Spatial Frequency*: The number of lines (or features) per unit length.

*Spatial Light Modulator*: An object that controls the amount of light passing through, such as a computer controlled micromirror device.

*Speckle Effect*: The shifting sparkling pattern you see when an expanded laser beam shines on a wall.

*Spectral Width*: The wavelength interval  $\Delta\lambda$  where the wavelength has at least some given fraction of the maximum power wavelength. Often this is the width of the curve at 50% the maximum power (full width half maximum).

*Spectrometer*: An instrument for measuring and recording optical spectra.

*Spectroscope*: Instruments for viewing spectra directly by the eye.

*Spherical Aberration*: The aberration (or blurriness) resulting from the spherical shape of lenses or mirrors.

*Spontaneous Emission*: Photons given off when an atom or molecule transitions at random, without outside stimulation, from an upper energy level to a lower one.

*Standing Waves*: Stationary wave vibrations that result when waves are traveling in two directions in a medium simultaneously.

*Step-Index Fiber*: Fiber in which there is a "step" change in index of refraction between the core and cladding

*Steradian*: The SI unit of solid angle. One steradian subtends an area on the surface of a sphere numerically equal to the radius squared.

*Stress Birefringence (Strain Birefringence)*: Birefringence that results in a material from applied force, for example, and a twisted piece of plastic.

*Stop Bath*: A process in photographic film development that stops the development by washing off the developing chemical or neutralizing it.

*Superposition*: The algebraic addition of two wave forms to create a different wave.

*Temporal Coherence (Longitudinal Coherence)*: Refers to the correlation in phase between points along the direction of propagation.

*Thermal Conductivity (k)*: Describes the rate at which a material will transmit heat

*Thermal Damage*: The result of extreme heating, for example, of the skin.

*Thermal Detector*: A detector that measures the heat generated when light is absorbed.

*Thermal Noise (Johnson Noise, Nyquist Noise)*: Refers to the random fluctuation of current (or electrons) in both the detector and its amplifying circuitry.

*Thermistors*: A type of resistor where resistance varies inversely with temperature.

*Thermocouple*: A temperature sensor consisting of a junction of two dissimilar metals. It measures the difference in temperature rather than absolute temperature.

*Thermopile*: A device that consists of multiple thermocouples arranged in an array used to convert heat energy to electrical energy.

*Thin Lens*: An approximation to a real lens where light enters and exits the lens at the same level.

*Thin Film*: A dielectric layer deposited on an optical device that is on the order of several wavelengths or microns thick.

*Tissue Engineering*: The use of light impinging on a tissue sample to alter tissue structure.

*Transmission Axis*: See *Polarization Axis*

*Transmission Grating*: A diffraction grating with grooves or index of refraction variations, used with transmitted light. A phase grating.

*Transmission Hologram*: When a holographic image is viewed by looking at light transmitted through the developed film.

*Transverse*: Perpendicular, for example, to the direction of wave propagation.

*Two Channel Hologram*: Shows a different image depending on the viewing angle.

*Umbra*: The inside darker area of a shadow where no light from an extended source falls.

*Uniphase Mode*: The Gaussian or TEM<sub>00</sub> mode of a laser.

*Valence Electrons*: Electrons in the outer shell of an atom. The valence electrons are responsible for chemical properties.

*Vertical Polarization*: The electric field vibrates vertically as the wave moves forward.

*Virtual Focus*: When incoming parallel rays of light are made to diverge by a lens or mirror, the point from which the diverging rays appear to emanate.

*Wave*: A disturbance that transmits energy from one point to another as it propagates through space and time.

*Wave Optics*: Light is treated as a wave phenomenon.

*Wave Packet*: A short burst of waves that travel together through a medium.

*Wave-Particle Duality*: Particles display wave-like behaviors in some situations.

*Wavefront Distortion*: The difference between the shape of a wave and its intended shape.

*Wavefront Division Interferometer*: Incoming waves are split along the wavefront perpendicular to the direction of propagation.

*Waveguide/Bend losses*: Loss due to imperfections and deformations in the fiber structure.

*Wavelength ( $\lambda$ )*: The distance over which the wave repeats itself.

*Wedge Prisms*: Prisms with very small apex angles are used to produce slight changes in the path of light.

*White Light*: Light containing all visible wavelengths.

*Young's Double-Slit Experiment*: Famous experiment of Thomas Young (ca 1802) passing spatially coherent light through closely spaced slits to reveal the wave nature of light.

*Zero Order Maximum*: Bright fringe formed at the center of an interference pattern