density in a linear conductor is equal to the current divided by the cross-sectional area of the conductor (IEV 05-20-045).

cycle. The complete range of states or values through which a phenomenon or periodic function passes before repeating itself identically (IEV 05-02-050).

depth of penetration. For a plane wave electromagnetic field, incident on the boundary of a good conductor, the depth of penetration of the wave is the depth at which the field strength of the wave has been reduced to 1/e, or approximately 37% of its original value.

dielectric constant. See permittivity.

dielectric material. A class of materials that act as electric insulators. For this class, the conductivity is presumed to be zero, or very small. The positive and negative charges in dielectrics are tightly bound together so that there is no actual transport of charge under the influence of a field. Such material alters electromagnetic fields because of induced charges formed by the interaction of the dielectric with the incident field.

dipole. A centre-fed open antenna excited in such a way that the standing wave of current is symmetrical about the mid point of the antenna (IEV 60-34-005).

directivity. That property of an antenna by virtue of which it radiates more strongly in some directions than in others (IEV 60-32-130).

dosimetry. The measurement or the determination by calculations of the internal electric field strength or induced current density, or of the specific absorption (SA) or specific absorption rate (SAR) distributions, in humans or animals exposed to electromagnetic fields and waves.

duty factor. The ratio of (1) the sum of pulse durations to (2) a stated averaging time. For repetitive phenomena, the averaging time is the pulse repetition period (IEV 531-18-15).

duty ratio. The ratio, for a given time interval, of the on-load duration to the total time (IEV 151-4-13).

effective radiated power in a given direction. The power supplied to the antenna multiplied by the gain of the antenna in that direction relative to a half-wave dipole (IEV 60-32-095).

electric field strength. The force on a stationary unit positive charge at a point in an electric field. This quantity may be measured in volts per metre (V/m).

electromagnetic energy. The energy stored in an electromagnetic field (IEV 121-01-39).

electromagnetic wave. A wave characterized by variation of the electric and magnetic fields (IEV 121-01-38).

exposure, intermittent. This term refers to alternating periods of exposure and absence of exposure varying from a few seconds to several hours. If exposure lasting a few minutes to a few hours alternates with periods of absence of exposure lasting 18-24 hours (exposure repeated on successive days), "repeated exposure" might be a more appropriate term.

exposure, long-term. This term indicates exposure during a major part of the lifetime of the biological system involved; it may, therefore, vary from a few weeks to many years in duration.

far-field or **far-zone.** See radiation zone and antenna regions.

field strength. In radio wave propagation, the magnitude of a component of specified polarization of the electric or magnetic field. The term normally refers to the root-mean-square value of the electric field (IEV 60-20-070).

Fraunhofer region. Of a transmitting [antenna] system, the region which is sufficiently remote from the [antenna] system for the

wavelets arriving from the various parts of the system to be considered to follow parallel paths (IEV 60-32-60).

free space. An ideal, perfectly homogeneous medium possessing a relative dielectric constant of unity, in which there is nothing to reflect, refract, or absorb energy. A perfect vacuum possesses these qualities.

Fresnel region. Of a transmitting [antenna] system, the region near the [antenna] system where the wavelets arriving from the various parts of the system cannot be considered to follow parallel paths (IEV 60-32-065).

frequency. The number of sinusoidal cycles made by electromagnetic waves in one second; usually expressed in units of hertz.

gain. The increase in power between two points 1 and 2 at which the power is respectively P_1 and P_2, expressed by the ratio P_2/P_1 in transmission units (IEV 55-05-185).

gigahertz (GHz). One billion (1 000 000 000) hertz.

hertz (Hz). One cycle per second.

horn. An elementary [antenna] consisting of a waveguide in which one or more transverse dimensions increase towards the open end (IEV 60-36-055).

hyperthermia. The condition of a temperature-regulating animal when the core temperature is more than one standard deviation above the mean core temperature of the species in resting conditions in a thermoneutral environment.

hypothermia. The condition of a temperature-regulating animal when the core temperature is more than one standard deviation below the mean core temperature of the species in resting conditions in a thermoneutral environment.

impedance, wave (at a given frequency). The ratio of the complex number (vector) representing the transverse electric field at a point,

to that representing the transverse magnetic field at that point. The sign is so chosen that the real part is positive (IEV 62-05-095).

induction zone; near zone. The region surrounding a transmitting antenna in which there is a significant pulsation of energy to and fro between the antenna and the medium. Note: The magnetic field strength (multiplied by the impedance of space) and the electric field strength are unequal and, at distances less than one tenth of a wavelength from an antenna, vary inversely as the square or cube of the distance, if the antenna is small compared with this distance (IEV 60-32-055).

irradiation, partial body. Exposure of only part of the body to incident electromagnetic energy.

irradiation, whole body. Exposure of the entire body to incident electromagnetic energy.

isotropic. Having the same properties in all directions.

isotropic radiator. An [antenna] which radiates uniformly in all directions. This is a hypothetical concept used as a standard in connection with the gain function (IEV 60-32-110).

kilohertz (kHz). One thousand (1000) hertz.

magnetic field strength. An axial vector quantity which, together with magnetic induction, specifies a magnetic field at any point in space. It can be detected by a small magnetized needle, freely suspended, which sets itself in the direction of the field. The free suspension of the magnetized needle assumes,however, that the medium is fluid or that a small gap is provided of such a shape and in such a direction that free movement is possible. As long as the induction is solenoidal, the magnetic field is irrotational outside the spaces in which the current density is not zero, so that it derives a potential (non-uniform) therefrom. On the other hand, in the interior of currents, its curl, in the rationalised system, is equal to the vector current density, including the displacement current. The direction of the field is represented at every point by the axis of a small elongated solenoid, its intensity and direction being such that it counterbalances all magnetic effects in its interior, whilst the field intensity is equal

to the linear current density of the solenoid (IEV 05-25-020). *Symbol*: H. *Unit*: ampere per metre (A/m).

megahertz (MHz). One million (1 000 000) hertz.

metabolic rate. See resting metabolic rate.

metastable. A state that is not stable, but will exist for a long period of time.

microwaves. Electromagnetic waves of sufficiently short wavelength that practical use can be made of waveguide and associated cavity techniques in their transmission and reception (IEV 60-02-025). Note: the term is taken to signify waves having a frequency range of 300 MHz-300 GHz.

modulation. The process of varying the amplitude, frequency, or phase of an RF carrier wave.

near-field. See induction zone.

non-ionizing radiation (NIR). Non-ionizing electromagnetic radiation incorporates all radiations and fields of the electromagnetic spectrum that do not normally have enough energy to produce ionization in matter. NIRs have an energy per photon less than about 12 eV, wavelengths longer than 100 nm, and frequencies lower than 300 THz.

permeability. The scalar or matrix quantity whose product by the magnetic field strength is the magnetic flux density. *Note*: For isotropic media, the permeability is a scalar; for anisotropic media, a matrix (IEV 121-01-37). *Synonym*: absolute permeability. If the permeability of a material or medium is divided by the permeability of vacuum (magnetic constant) m, the result is termed **relative permeability**. *Symbol*: μ. *Unit*: henry per metre (H/m).

permittivity; dielectric constant. A constant giving the influence of an isotropic medium on the forces of attraction or repulsion between electrified bodies (IEV 05-15-120). *Symbol*: ϵ. *Unit*: farad per metre (F/m).

permittivity; relative. The ratio of the permitivity of a dielectric to that of a vacuum (IEV 05-15-140). *Symbol*: ϵ_r.

phase. Of a periodic phenomenon, the fraction of a period through which the time has advanced relative to an arbitrary time origin.

plane wave. An electromagnetic wave in which the electric and magnetic field vectors lie in a plane perpendicular to the direction of wave propagation.

polarization. A vector quantity representing the state of dielectric polarization of a medium, and defined at each point of the medium by the dipole moment of the volume element surrounding that point, divided by the volume of that element (IEV 05-15-115).

polarization, plane of. In a linearly polarized wave, the fixed plane parallel to the direction of polarization and the direction of propagation. *Note*: In optics the plane of polarization is normal to the plane defined above (IEV 60-20-010).

power flux density. In radio wave propagation, the power crossing unit area normal to the direction of wave propagation (IEV 60-20-075). *Symbol*: W. *Unit*: watts per square metre (W/m^2).

power (surface) density. Radiant power incident on a small sphere, divided by the cross-sectional area of that sphere.

power gain of an antenna (in a given direction). The ratio, usually expressed in decibels, of the power that would have to be supplied to a reference antenna to the power supplied to the antenna being considered, so that they produce the same field strength at the same distance in the same direction; unless otherwise specified, the gain is for the direction of maximum radiation; in each case the reference antenna and its direction of radiation must be specified. For example: half-wave loss-free dipole (the specified direction being in the equatorial plane), an isotropic radiator in space (IEV 60-32-115). *Symbol*: G. *Unit*: decibel (dB).

Poynting vector. A vector, the flux of which through any surface represents the instantaneous electromagnetic power transmitted through this surface (IEV 05-03-85). *Synonym*: power flux density.

pulse amplitude. The peak value of a pulse (IEV 55-35-100).

pulse duration. The interval of time between the first and last instant at which the instantaneous value of a pulse (or of its envelope if a carrier frequency pulse is concerned) reaches a specified fraction of the peak amplitude (IEV 55-35-105).

pulse output power. The ratio of (1) the average output power to (2) the pulse duty factor (IEV 531-41-14).

pulse repetition rate. The averge number of pulses in unit time during a specified period (IEV 55-35-125).

radar. The use of radiowaves, reflected or automatically retransmitted, to gain information concerning a distant object. The measurement of range is usually included (IEV 60-72-005).

radiation field. That part of the field of an [antenna] which is associated with an outward flow of energy (IEV 60-32-040).

radiation pattern; radiation diagram; directivity pattern. A diagram relating power flux density (or field strength) to direction relative to the [antenna] at a constant large distance from the [antenna]. *Note*: Such diagrams usually refer to planes or the surface of a cone containing the [antenna] and are usually normalized to the maximum value of the power flux density or field strength (IEV 60-32-135).

radiation zone. The region sufficiently remote from a transmitting antenna for the energy in the wave to be considered as outward flowing. *Note*: In free space, the magnetic field strength (multiplied by the impedance of space) and the electric field strength are equal in this region and, beyond the Fresnel region, vary inversely with distance from the antenna. The inner boundary of the radiation zone can be taken as one wavelength from the antenna if the antenna is small compared with the distance (IEV 60-32-050).

radiofrequency (RF). Any frequency at which electromagnetic radiation is useful for telecommunication (IEV 55-05-060). *Note*: in this publication RF refers to the frequency range 300 Hz-300 GHz.

reflected wave. A wave, produced by an incident wave, which returns in the opposite direction to the incident wave after reflection at the point of transition (IEV 25-50-065).

resonance. The change in amplitude as the frequency of the wave approaches or coincides with a natural frequency of the medium. The whole-body absorption of electromagnetic waves presents its highest value, i.e., the resonance, for frequencies (in MHz) corresponding approximately to 114/L, where L is the height of the individual in metres.

resting metabolic rate (RMR). The metabolic rate of an animal that is resting in a thermoneutral environment, but not in the postabsorptive state. The relationship of RMR (W/kg) to body mass, M (kg), is $RMR = 3.86M^{-0.24}$ Basal metabolic rate (BMR) is the rate of energy production of an animal in a rested, awake, fasting, and thermoneutral state.

root mean square (RMS). Certain electrical effects are proportional to the square root of the mean value of the square of a periodic function (over one period). This value is known as the effective value or the root-mean-square (RMS) value, since it is derived by first squaring the function, determining the mean value of this squared value, and extracting the square root of the mean value to determine the end result.

scanning. Of a radar [antenna], systematic variation of the beam direction for search or angle tracking (IEV 60-72-095). The term is also applied to periodic motion of a radiocommunication antenna.

scattering. The process by which the propagation of electromagnetic waves is modified by one or more discontinuities in the medium which have lengths of the order of the wave length (IEV 60-20-120); a process in which a change in direction or energy of an incident particle or incident radiation is caused by a collision with a particle or a system of particles (ISO 921). The extent to which the intensity of radiation is decreased in this manner is measured in terms of the **attenuation coefficient (scattering)**.

shield. A mechanical barrier or enclosure provided for protection (IEV 151-01-18). The term is modified in accordance with the type

of protection afforded; e.g., a magnetic shield is a shield designed to afford protection against magnetic fields.

specific absorption (SA). The energy absorbed per unit mass of biological tissue, expressed in joules per kilogram (J/kg). SA is defined as the quotient of the incremental energy absorbed by, or dissipated in, an incremental mass contained in a volume element of a given density. SA is the time integral of specific absorption rate (SAR).

specific absorption rate (SAR). The rate at which energy is absorbed in body tissues, in watts per kilogram (W/kg). SAR is defined as the time derivative of the incremental energy absorbed by, or dissipated in, an incremental mass contained in a volume element of a given density. SAR is the dosimetric measure that has been widely adopted at frequencies above about 100 kHz.

temperature regulation. The maintenance of the temperature or temperatures of a body within a restricted range, under conditions involving variable, internal and/or external heat loads. Biologically, the existence of some degree of body temperature regulation by autonomic or behavioural means.

temperature regulation, autonomic. The regulation of body temperature by autonomic (i.e., involuntary) responses to heat and cold, which modify the rates of heat production and heat loss (i.e., by sweating, thermal tachypnea, shivering, and variations in peripheral vasomotor tone and basal metabolism).

temperature regulation, behavioural. The regulation of body temperature by complex patterns of responses of the skeletal musculature to heat and cold, which modify the rates of heat production and/or heat loss (e.g., by exercise, change in body conformation, and in the thermal insulation of bedding and, in humans, of clothing, and by the selection of an environment that reduces thermal stress).

thermal effect. In the biological tissue or system, an effect that is related to heating of the tissue through the application of electromagnetic fields, and that can occur through other forms of heating.

thermogenic levels. Power densities of RF that produce a measurable temperature increase in the exposed object.

thermoneutral zone. The range of ambient temperature within which metabolic rate is at a minimum, and within which temperature regulation is achieved by nonevaporative physical processes alone.

thermoregulation. See temperature regulation.

wave. A modification of the physical state of a medium which is propagated as a result of a local disturbance (IEV 05-03-005).

waveguide. A system for the transmission of electromagnetic energy by a wave not of TEM type. It may, for example, consist of a metal tube, a dielectric rod or tube, or a single wire (IEV 62-10-005).

wavelength. The distance between two successive points of a periodic wave in the direction of propagation, in which the oscillation has the same phase (IEV 05-03-030). *Symbol*: λ. *Unit*: metre (m).

wave, plane. A wave such that the corresponding physical quantities are uniform in any plane perpendicular to a fixed direction (IEV 05-03-010).

wave, transmitted. A wave (or waves) produced by an incident wave which continue(s) beyond the transition point (IEV 25-50-060).

wave, transverse. A wave characterised by a vector at right angles to the direction of propagation (IEV 05-03-070).

whole-body exposure. Pertains to the case in which the entire body is exposed to the incident electromagnetic energy or the case in which the cross section (physical area) of the body is smaller than the cross section of the incident radiation beam.

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