

MICROWAVE AND OPTICAL SYSTEMS FOR CABLE NETWORKS

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Introduction to waveguides. Electromagnetic field in a cylindrical dielectric structure of arbitrary section: modal theory. Metallic waveguides: modes TE, TM, TEM. Unimodal bandwidth. Phase velocity, propagation constant and waveguide impedance. Rectangular metallic waveguide: TE and TM modes, dominant mode, first higher modes and unimodal bandwidth. Circular metallic waveguide: Bessel functions, TE and TM modes, dominant mode and unimodal bandwidth. Coaxial cable: TEM mode, higher modes and unimodal bandwidth. Power computation in a waveguide. Orthogonality between modes in metallic waveguide.

Free-space and guided lossy propagation. Metallic waveguides: Leontovic condition, perturbation theory and computation of the attenuation for TE, TM and TEM modes. Application to rectangular and circular waveguide, and to coaxial cable. Ridged waveguide. Voltage and current and related parameters in coaxial cables. Phase velocity and group velocity. Analysis of wave packet.

Dielectric waveguides: boundary conditions and modal theory, guided modes, irradiant modes and evanescent modes. Stripline and Microstrip line.

Waveguide dielectric slab: modal theory, characteristic equation, odd modes (TE and TM), even modes (TE and TM). Circular dielectric waveguide: characteristic equation, TE and TM modes, hybrid modes EH and HE. The dominant mode HE₁₁ and the first higher modes. LP modes and characteristic equation. Attenuation and dispersion in optical fiber transmissions. LED and LASER generators. Fotodyodes PIN and APD. Error probability in a system with intensity modulation and direct demodulation. (IM/DD).

Line transmission equivalent circuit of a mode in waveguide: mode function and normalization.

N-ports linear networks. Impedance and admittance matrices and scattering matrix S. Active power absorbed by a N-port network. Passive, dissipative, active and loss-free networks. S matrix of a two-port network. Reciprocal loss-free network. Transformation of reflection coefficient. Limit circle. Equivalent T and Π circuits for reciprocal two-port networks. Reciprocal loss-free two port network: model involving ideal transformer with input and output lines. Two port network inserted between generator and load in a transmission line: computation of the active input and output power. Microwave components: flange junction, choke joint, Absorbing loads. Fixed and variable attenuators. Non-dissipative attenuators. Impedance matching. Ideal attenuators. Insulators. Phase variators. Three-port networks. Non-adaptability of free-loss reciprocal three port networks. Circulators, Applications of circulators: parametric amplifier, insulator, diplexer, branch filter. Y-symmetric three port networks. T-parallel networks. T-series networks. Four ports networks: directional couplers and related parameters. Hole couplers. Riblet hybrid junction. T-hybrid network. T-magic. T-magic loaded with three (or two) ports.

Resonant cavities. Quality factors. Principles on klystron and klystron reflex.