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| **Part I Transmission Technology 3 hrs/week** |

**First part: *Propagation of Electromagnetic Waves and Transmission Lines***

**Contents:**

***Chapter 1:* Propagation of electromagnetic waves (8h)**

1.1. Electrical to electromagnetic conversion.

1.2. Electromagnetic waves:

1.2.1. Wave fronts.

1.2.2. Intrinsic impedance of free space.

1.3. Propagation phenomenon:

1.3.1. Reflection.

1.3.2. Refraction.

1.3.3. Diffraction.

1.4. Ground and space wave propagation:

1.4.1. Ground wave propagation.

1.4.2. Space wave propagation.

1.4.3. Ghosting in television reception.

1.4.4. Tropospheric duting.

1.4.5. Calculation of the distance between transmitter and receiver.

1.5. Sky wave propagation:

1.5.1. Ionospheric layers.

1.5.2- Effects of the ionosphere on the sky wave:

1.5.3. Critical frequency.

1.5.4 - Critical angle.

1.5.5 - Maximum usable frequency (MUF).

1.5.6 .Suitable radiation angles.

1.5.7 . Skip zone.

1.5.8. Fading.

1.5.9. Tropospheric scatter.

1.6. Classification of electromagnetic waves according to the frequency and the propagation mode.

***Chapter 2*: Transmission lines: (10h)**

2.1. Equivalent circuit of lossy transmission line:

2.1.1. Resistance per unit length R.

2.1.2. Inductance per unit length L.

2.1.3. Conductance per unit length G.

2.1.4. Capacitance per unit length C.

2.1.5. Characteristic impedance.

2.1.6. Attenuation of the wave in the transmission line α (Without mathematical analysis).

2.1.7. Propagation constant of the wave in the transmission line γ (Without mathematical analysis).

2.1.8. Phase constant of wave β (Without mathematical analysis).

2.1.9. Exercises.

2.2. Equivalent circuit of loss-less transmission line:

2.2.1. Inductance per unit length L.

2.2.2. Capacitance per unit length C.

2.2.3. Characteristic impedance.

2.2.6. Attenuation of the wave in the transmission line α.

2.2.7. Propagation constant of the wave in the transmission line γ.

2.2.8. Phase constant of wave β.

2.2.9. Exercices.

2.3. Matching techniques:

2.3.1. Reflection coefficient.

2.3.2. Standing wave ratio.

2.3.3. Matching conditions.

*2.*4.Types of transmission lines.

2.4.1. Two-parallel wire and coaxial lines:

2.4.2. Line geometries.

2.4.3. Equivalent circuit.

2.4.4. Characteristic impedance.

2.5. Rectangular and circular wave guides:

2.5.1. Guide geometries.

2.5.2. Propagation modes.

2.5.3. Guided wavelength.

2.5.4. Cut-off frequencies.

2.5.5. Impedances.

2.5.6. Exercises.

**Second part: *Fiber Optics*:**

***Chapter 3*: Fiber optics: (6 h)**

3.1. Operational bloc diagram of a transmission system using fiber optics.

3.2. Characteristics and advantages of fiber optics.

3.3. Fiber optic transmission line (core, cladding, refractive indices, propagation using ray theory).

3.4. Types of cables (Multi-mode step index, Multi-mode graded index, single mode graded index).

3.5. Optical sources and detectors (LED source, LASER source, Photodiode and Phototransistor).

**Third part 3: *Antennas:***

***Chapters 4*: Antenna parameters: (3 h)**

4.1. Introduction to antennas (propagation ofelectromagnetic waves in free space, communication system using antennas.

4.2. Parameters(polarization, directivity and gain, radiation pattern, effective length and area, radiation resistance and radiation pattern).

***Chapter 5:* Types of Antennas: (9 h)**

5.1. Simple dipole, folded dipole.

5.2. Set of antennas:

5.2.1. Collinear.

5.2.2. Set of parallel antennas.

5.2.3. Set of antennas supplied in quadrature.

5.3. Rhombus antenna.

5.4. Yagi antenna (construction, parameters and applications).

6.5. Horn antenna.

6.6. Parabolic antenna.

6.7. Loop antenna.

6.8. Helical antenna.

For each antenna treat the following point: construction, parameters, principle of operation, pattern diagram and applications.

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| **Part II Telephony 3h/week** |

**Chapter 1: Introduction (4h)**

1. Role and objective.
2. Interconnection network.

1.3. Director plans of architecture.

**Chapter 2: The telephone exchange (10h)**

2.1. General architecture.

2.2. Comparison between the transmission and reception signals in analog and digital telephony.

2.3. The block diagram of the digital telephony apparatus, role of each block.

2.4. The block diagram of the microphone-earphone, role of each block.

2.5. The block diagram of the speakerphone circuit, role of each block.

2.5. The block diagram of the alarm circuit, role of each block.

2.6. The keywords.

**Chapter 3**: **The Auto switch (PBX) (4h)**

3.1. Introduction.

3.2. Connection function.

3.3. Signaling function.

3.4. Command function.

**Chapter 4: The Traffic: dimensioning** **a server (4h)**

4.1. Definition of the traffic.

4.2. Mathematical model.

4.3. System have lost calls.

4.4. System have waiting delays.

**Chapter 5: Transmission of telephone signals (4h)**

5.1. Elaboration of the digital telephone.

5.2. The PCM with 30 channels.

5.3. Space connection.

5.4. Temporal connection.

**Chapter 6 : Cellular network (10h)**

6.1. Introduction.

6.2. Cellular concepts.

6.3. The MS terminal and SIM card.

6.4. Canonical Architecture.

6.5. Technical dimensioning of the network.

6.6. Radio resource management.

6.7. Four generations:

-Definitions of four technologies 1G, 2G, 3G and 4G.

-Characteristics and speed of transmission for each technology (Comparative table).

-Advantages and disadvantages of the four technologies.