

Waveguides and Antennas

1. **Course number and name:** 020PGAES3 Waveguides and Antennas
2. **Credits and contact hours:** 4 ECTS credits 2x1:15 contact hours + 5 lab hours
3. **Name(s) of instructor(s) or course coordinator(s):** Elias Rachid
4. **Instructional materials:** Course handouts; lab experiments; slides; in-class problems

5. Specific course information

a. Catalog description:

Transmission line theory – Lines in sinusoidal and transient regimes – Smith chart – TOS and stub adaptation – Waveguides (parallel plate, rectangular, cylindrical and dielectric) – General solutions for TEM, TE and TM waves – Fundamental parameters of antennas, gain and power directivity – Dipole antenna and linear wire antennas. Array antennas – Horn and reflector antennas (terrestrial antenna) – Smart antennas – Adaptive and switched-beam antennas.

b. Prerequisites: 020EMENI3 Electromagnetism or 020EMECI3 Electromagnetism

c. Required for CCE Telecommunication Networks option students; **Selected Elective** for CCE Software Engineering students

6. Educational objectives for the course

a. Specific outcomes of instruction:

- Study and analyze the lines in sinusoidal and transient regimes.
- Analyze and calculate the nature and the type of defaults encountered on a transmission line.
- Use SMITH chart to solve line problem and adapt any line with a stub.
- Analyze and familiarize with the Maxwell equations and propagation in the different guides.
- Determine the expressions of the electromagnetic fields in the waveguides Calculate the near and far fields, the gain and the equivalent area of any dipole, half-wave doublet and of the horn and reflector antennas.
- Find the antenna radiation pattern and antenna array.
- Recognize intelligent antenna techniques.
- Synthesizing adaptive printed antennas.

b. PI addressed by the course:

PI	1.1	1.2	6.2	6.3	6.4	2.3
Covered	x	x	x			x
Assessed	x	x	x	x	x	x

7. Brief list of topics to be covered

- Guided propagation: Study of the lines in sinusoidal and transient regimes: Telegraph equations, calculation of impedances, lossless lines, Stationary wave rate (3 lectures)
- Study of Smith's chart and applications: construction of the chart, impedance calculation, TOS calculation, stub adaptation (3 lectures)
- Rectangular waveguide: TE and TM waves, reflection on a conductor plane, propagation in parallel plate and rectangular waveguide: field expressions for TE and TM modes, wave unit Losses in a guide, cavities and applications (3 lectures)
- Cylindrical waveguide TE and TM waves, EM-field expressions (2 lectures)
- Dielectric waveguide: TE and TM wave, EM-field expressions for TE and TM modes (1 lecture)
- Antennas: Antennas parameters, isotropic source, image theory, radiation pattern, gain, directivity, radar equation (2 lectures)
- Wire antennas: near and far fields of wire antenna, input impedance, effects of capacitors and inductances in an antenna, line wire antennas, bandwidth (3 lectures)
- Antenna alignment: N-points source grouping, alignment factor, reflector, dipole, Yagi antenna, AM, FM and TV antennas (3 lectures)
- Microwave antennas: Parabolic and reflector antennas, inclined beam on a parabolic (2 lectures)
- Intelligent antennas: adaptive and switched beam (2 lectures)
- Laboratory experiments (4 lectures)