Pre-Class Delivery Questions:

- Briefly describe the context of the class period and how it fits into the syllabus/goals of the course.

Goal of the class is to introduce students to rectangular horn antennas. This class will give them a first Conceptual overview on the topic.

- What are the learning objectives of the lesson for the day you are teaching?

See lesson plan

- Briefly describe your lesson plan for the day (or include a written copy of your lesson plan) and briefly describe your rationale for the instructional methods you have chosen.

See attached notes.

- How will you know if you accomplished your objectives for the day (assessment)?

Along the class I will make the students work through assigned problems related to what they will learn in class.

- What feedback do you want on your lesson plan and/or what questions do you have (for your peers/mentor)?

How are the students reacting to the group activity, are they working? Are they interacting among themselves?

- In terms of your development as a teacher, what are your personal goals for this lesson?

Simplify (without making it too simple) a topic often not well understood by the students or well taught by professors.

Lesson Plan – Practicum Template

Your Name: Francesco Amato

Course Title: Antenna Engineering

Estimated # of students in course/attending your lesson: 50

Room Configuration: big room with wide tables

Course Goals:

These do not need to be properly written, include whatever is on the current syllabus for this course.

Check here if the lesson helps met this course goal. Leave empty if the lesson doesn't help meet this course goal.	List course goal in each row.
x	1. Design antenna systems for wireless communications
	2. Radar
	3. Power transfer systems

Lesson Topic:

Rectangular horn antennas

Lesson Learning Objectives (Where are you going?):

Place all of the objectives for this specific lesson here. All objectives must be: specific, measurable, action-oriented, concrete, learner-centered, observable, and appropriate to the context (situational factors and course goals). For each objective, please list which domain it falls into (cognitive, affective, and psychomotor).

SB1. Students will analyze the nature of relationships between structures and functions in living cells.

a. Explain the role of cell organelles for both prokaryotic and eukaryotic cells, including the cell membrane, in maintaining homeostasis and cell reproduction
b. Explain how enzymes function as catalysts
c. Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic acids)
d. Explain the impact of water on life processes (i.e., osmosis, diffusion)

List lesson objectives (one per row).	Domain
1. Review of waveguides	Cognitive
2. Overview of rectangular horn antennas	Cognitive
3. Phase errors	Cognitive
4. Horn Antenna directivity and patterns	Cognitive

Instructor Preparation:

Long term: Prepare handouts and power point presentation. Identify real life scenario to make student familiarize with horn antennas through practical problems
Short term: review formulas, organize the available time, check projector and sharpies to write on the board.

Materials & Supplies (besides associated files):

Devices from the lab will be showed in class: waveguide feeder, pyramidal horn antenna, modified horn antenna.

Agenda:

Break the lesson into component parts and include how long the part will take. Please add additional rows if you need them.

# of Minutes	Start Time:	End Time:	Name of Teaching/Learning Activity
5	13.35	13.40	Intro, history, design overview
20	13.40	14.00	Probe, waveguide review, first exercise
30	14.00	14.30	Horn antennas: drawing, analogy with arrays, top and side views, phase error, Aopt, Bopt, second exerice
25	14.30	14.55	Pyramidal horn, third exercise, gains, flares, fourth exercise

There are several aspects that can be highlighted about horn antennas. The most important concepts are:

1) **The reasons that allow high gains (or directivities) in horn antennas**
2) **How the aperture inlfuences the shape of the radiation pattern**
3) **How the phase error affects the maximum achievable gain and limits the maximum size of a horn antenna.**
4) **The practical solutions used by manufacturer to improve the gains. Solutions that have not been yet described in a theoretical way but are just based on best practices.**

Horn antennas have been known since the discovery of antennas. There is a huge literature about them and many complex mathematical models have been developed.

Aim of this class of to make understand the students the reasons of some physical behaviors by using intuitive concepts, without relaying of the complex mathematical models.

Assessment:

Students will work in small group and analyze the data sheet of a pyramidal horn antenna to apply some concepts and formula showed in class to observe:

- How the waveguide sizes affect the frequency range of operation
- How the aperture size can help to predict the gain (and directivity)
- How the angle of aperture allow to estimate the radiation pattern (if time allows)

Among the 4 exercises, the first two will be assessed by using poll everywhere, while the last two, will be used to foster discussion with the class.

Contingencies:

There might be too much or too little time to complete the whole lesson.
The most important and interesting concepts can be introduced only towards the end of the lesson. Nevertheless, it is important for the student to first understand the introductory concept in order to have a clear understandings of the phenomenon that will be seen towards the end: e.g.: how the shape of the radiation pattern is affected by the geometry of the pyramidal horn.

$$(f_c)_{mn} = \frac{1}{2\sqrt{\varepsilon\mu}} \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}$$

$$\tilde{E}_y(x, y, z) = E_0 \cos\left(\frac{\pi x}{a}\right) e^{-j\beta z}$$

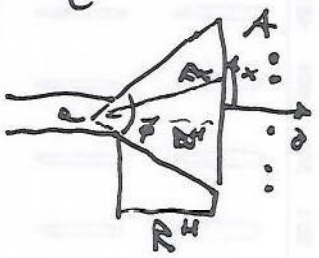
$e^{-j\beta(R_x - R_0^H)}$

Sectorial H

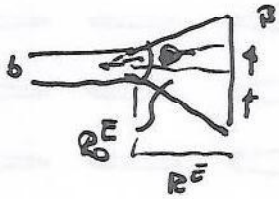
Sectorial E

Pyramidal

Top View



Side View



$A_{opt} = \sqrt{3\lambda R_0^H}$

$B_{opt} = \sqrt{2\lambda R_0^E}$

$$\frac{R_0^H}{R^H} = \frac{A}{A-a}$$

$$\frac{R_0^E}{R^E} = \frac{B}{B-b}$$

$$D = \frac{\pi}{32}\left(\frac{A}{a} D^E\right)\cdot\left(\frac{\lambda}{b} D^H\right)$$

$$G = \frac{4\pi}{\lambda^2} \cdot A \cdot B \cdot \eta_A$$

Lecture: Horns & Reflectors
History
Design overview
] 5 slides

Design: Probe
Waveguide review and comments
1st Exercise & Comments
] 20 slides

Horns: Drawings
Analogy with Arrays
Top & Side Views
Phase Error → Directivity Plots of H-horns
Phase Comments with Drawings
Aopt, Bopt
2nd Exercise
] 30 slides

Pyramidal horns
- Directivity
- Ex. 3
- Gain
- Flares & Polarizers
- Ex. 4

] 30 slides