GENERAL COURSE INFORMATION:

REFLECTOR ANTENNAS

Spring semester of 2013

EE 578 – Lec 30755D and 30761R

Welcome to REFLECTOR ANTENNAS, a course covering the basic material required to design and analyze reflector antennas. This course has 14.5 lectures, 12 homeworks, 1 midterm exam, and one final exam. Below are relevant information concerning this course; feel free to clarify any additional points that you may have directly with the instructor.

Prerequisite: EE 470 or equivalent.

Credit: 3 units.

Instructor: Prof. Aluizio Prata, Jr. [office: PHE 618;
tel. (213) 740-4704; email: prata@usc.edu].

Text: Class notes. Detailed homework solutions are provided.

Lectures: Friday 09:00 – 10:20, 10 min. break, 10:30 – 11:50.

Location: OHE 100C.

Instructor Office Hours: Tuesday and Thursday,
11:00 to 11:45 and 14:00 to 17:15

Material covered and homework schedule:

Week #	**HWK due**	**Material Covered**
1		Review of EM-Theory. Maxwell's equations. $e^{+j\omega t}$ time dependence. Poynting vector (usage with complex notation). Radiation from current distributions (Stratton and Chu's formula).

2		Radiation from current distributions (cont.). Free space dyadic Green's function. Hertz dipole example. Near- and far-zone computations
3	HWK 01	Equivalent currents. Uniqueness theorem for EM-fields. Field equivalence theorems (Love's equivalence). Image theory. Physical Optics surface current approximation (the PO method). Radiation from apertures.
4	HWK 02	Radiation from a circular aperture on an electric conductor ground plane; relevant radiation pattern features. Effect of the ground plane mounting (aperture in magnetic conductor ground plane). Isotropic radiator. Gain and directivity. Friis' formula.
5	HWK 03	Maximum gain of a planar aperture with arbitrary shape. Impact of small illumination errors on the aperture gain. Reciprocity theorem. Polarization. Three acceptable polarization definitions. Ludwig's third polarization definition
6	HWK 04	Geometrical Optics (derivation from Maxwell's equations). Rays (and corresponding properties) Reflection by a conducting surface. Wavefront geometry (principal curvatures and directions of principal curvatures). Energy flow in a ray tube.
7	HWK 05	Caustic behavior (Gouy phase shift). GO field formula. Examples of GO computations. Stationary phase principle. Connection between the

		GO formula and the radiation integral.
8	HWK 06	Fermat's principle and Snell's law, their equivalence and when to use each one. Reflection points and how to determine their location. Law of the optical path. Derivation of the paraboloidal, hyperboloidal, and elipsoidal reflectors equations
9		Computing the paraboloidal reflector radiation characteristics using the aperture-field method Paraboloidal reflector co- and cross-polarization. Why Ludwig's 3rd. polarization definition is so good and convenient
10	HWK 07	Aperture fields of axially symmetric and offset paraboloidal reflectors. Cross-polarization properties of offset paraboloids Computing paraboloidal reflectors' scattered field using the PO method.
11	HWK 08	Design of axially symmetric paraboloidal reflector antennas. Antenna efficiency, aperture efficiency, spillover, etc Estimating the required edge taper for maximum gain. Design of offset paraboloidal reflectors
12	HWK 09	Formulas and conic-section properties. Classical axially symmetric dual-reflector antennas. Classical offset dual-reflector antennas. Equivalent paraboloid concept. Design of classical offset dual-reflector antennas.
13	HWK 10	Application of the stationary-phase principle to reflector rims; Edge diffracted rays. Generalized Fermat's principle–cone of diffracted rays Diffraction points and how to determine their position. Sommerfeld's half-plane problem. Dyadic diffraction coefficient. Approximation of the reflector rim by a circle.

14	HWK 11	Ray fixed coordinate system. Keller's GTD. Kouyoumjian and Pathak's GTD. Reflection and shadow boundaries. Kouyoumjian and Pathak's transition function. Discussion of GTD. Typical results. Comparison with PO. How to use GTD–a step by step aproach.
15	HWK 12	Vertex diffracted rays. Creeping waves. Whyspering gallery waves. APO, PTD, Lee's GTD, and all that. How to debug a GTD code. Shaping axially-symmetric dual-reflector antennas for a prescribed aperture field. How many integration steps are needed in the reflector scattering PO integrations.

The homework is due *at the beginning* of the corresponding lecture, on the due date. No late homeworks are accepted.

Exam schedule:

Exam	**Date**	**Time**	**Location**	**Material Covered**
Midterm	Fri., Mar. 15	09:00–10:20	OHE 100C	Assignments 1–7
Final	Fri., May 10	08:00–10:00	OHE 100C	All course material

All exams are of the closed-book open-notes type. You may also use a calculator. You are responsible for all material covered in class, on the assigned readings, and on the homework problems.

You must take the exams at the scheduled times. If you are absent during an exam, you will receive a zero grade unless you have a valid reason for your absence, *and* you have discussed it with Prof. Prata *prior* to the exam. Bring your USC ID card to each exam; it may be checked during the exam.

Grading Policy: The final grade of the course is computed using an weighted average of the midterm exam (with 20% weight), the final exam (with 40% weight), and of the thirteen homeworks (their average weighted by 40%).