ECE 4300, Fall Semester 2016
Lasers and Optoelectronics

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Assignment 2

Present your solutions *neatly*. Do not turn in rough unreadable worksheets - learn to **take pride in your presentation**. Show the relevant steps, so that partial points can be awarded. BOX your final answers where applicable. Draw figures wherever necessary. **Please print out the question sheet(s) and staple to the top of your homework.** Write your name, email address, and date/time the assignment is turned in on the cover.

Note: Assignment 1 has additional directions on deadlines, and rules for collaborative work.

Posted on: Friday, 9/16/2016. Due on: 9/26/2016, Monday

Problem 2.1 (Gain and escape from an unstable cavity)
Verdeyen Problem # 2.10.

Problem 2.2 (Basics of Gaussian Beams and Laser Fields & Photons)
Verdeyen Problem # 3.2.

Problem 2.3 (More practice in Gaussian Beam Propagation)
Verdeyen Problem # 3.4.

Problem 2.4 (Higher order Laser modes)
Verdeyen Problem # 3.7.

Problem 2.5 (Gaussian Beam ABCD Matrix for a Nonuniform Mirror)
Verdeyen Problem # 3.19.

Problem 2.6 (Practice ABCD Law on Gaussian Beams in Optical Cavities)
Verdeyen Problem # 5.1.

Problem 2.7 (Maximizing the Mode Volume)
Verdeyen Problem # 5.4.

Problem 2.8 (Spot size, Photon Lifetime, and Quality Factor of a CO_2 Laser)
Verdeyen Problem # 5.11.

Problem 2.9 (Write your own computer program for ray tracing) Develop a well-structured computer program that plots out the traces that a ray takes in traversing a stable cavity. You can use any programming language you like, the challenge (probably) will be in finding a way to produce the graphics output. Required input: curvature of each mirror,

location of each mirror, a starting ray, and the desired number of round trips the ray should make. The program should compute the position of the ray as it makes the series of bounces through the cavity and finally produce a graphic showing the complete bounce path. You can choose any radii and length you like. Your program should calculate a cavity with at least 2 mirrors. Credit will be given for clean coding, good but concise documentation, and the ability to re-use the functions in future programs. An example output is shown in Figure 1 using Mathematica, you can surely do much better!

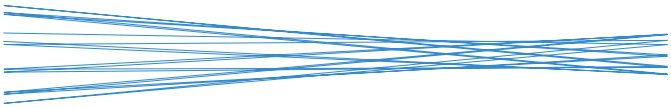

Figure 1: An example of a Mathematica-generated ray tracing in two-mirror cavity with 10 bounces, with radii of curvatures 400 and 213 cm separated by 500 cm.