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# ECE 4300, Fall Semester 2016

## Lasers and Optoelectronics

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### Assignment 5

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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, 10/28/2016. Due on: 11/09/2016, Wednesday**

#### **Problem 5.1 (Mode Selection by Intracavity Etalon)**

An inhomogeneously broadened Argon-ion laser is oscillating at  $\lambda = 514.5$  nm transition and of linewidth  $\Delta\nu = 3.5$  GHz. The total cavity loss per pass is  $\alpha = 4\%$ . The unsaturated peak gain  $e^{\sigma Nl} = 1.3$ , and the cavity length is  $d = 100$  cm. To select one mode, a tilted (tilt angle  $\theta \approx 0$ ) quartz Fabry-Perot etalon of refractive index  $n = 1.45$  and thickness  $t = 2$  cm is used inside the resonator.

- (a) Assuming a cavity mode is coincident with the center peak transition, calculate the reflectivity of the identical etalon faces to ensure single-mode operation.
- (b) Find the etalon finesse.

#### **Problem 5.2 (Laser Gain Saturation: Small-Signal vs Large-Signal Gain)**

Verdeyen Problem # 8.32.

#### **Problem 5.3 (An Optical Amplifier)**

Verdeyen Problem # 9.6.

#### **Problem 5.4 (A Q-Switched Ruby Laser)**

Verdeyen Problem # 9.17.

#### **Problem 5.5 (A Q-switched YAG Laser)**

Verdeyen Problem # 10.25.

#### **Problem 5.6 (Saturable Absorber)**

Verdeyen Problem # 9.23.

#### **Problem 5.7 (Mode-Locked Laser)**

Verdeyen Problem # 9.27. (Continued on the next page...)

**Problem 5.8 (Optimal Output Coupling)**

Verdeyen Problem # 9.31.

**Problem 5.9 (Mode Locked Laser)**

Verdeyen Problem # 9.36.

**Problem 5.10 (Mode Locked Argon-Ion Laser)**

Verdeyen Problem # 10.17.