EEL 4447    Laser Theory and Design

1. **Catalog Description** – (3 credits) Study of lasers from basic principles to operational characteristics.

2. **Pre-requisites** - EEL 4473 and EEL 4458 or consent of instructor

3. **Course Objectives** - The student will learn the basic principles of operation, analysis, and design of several types of lasers used in modern engineering applications.

4. **Contribution of course to meeting the professional component** (ABET only – undergraduate courses) - 1.5 credits of Engineering Design, 1.5 credits of Engineering Science

5. **Relationship of course to program outcomes** (ABET only undergraduate courses) - EE2, EE3, a, c, e, i

6. **Instructor** – Dr. Henry Zmuda  
   a. Office location: 235 Larsen Hall  
   b. Telephone: 392-0990  
   c. E-mail address: zmuda@ece.ufl.edu  
   d. Web site: www.zmuda.ece.ufl.edu  
   e. Office hours: MWF 4th or by appointment

7. **Teaching Assistant** - None

8. **Meeting Times** - MWF 2nd

9. **Class/laboratory schedule** - 3 class periods consisting of 50 minutes ea

10. **Meeting Location** - Benton 328

11. **Material and Supply Fees** - None

12. **Textbooks and Software Required**  
    a. Title: Laser Electronics  
    b. Author: Joseph T. Verdeyen  
    c. Publication date and edition: Prentice Hall, 3rd edition (July 29, 1995)  
    d. ISBN number: 0-13-706666-x

13. **Recommended Reading** – None

14. **Course Outline**  
    Weeks 1-2: Gaussian Beams  
                TEM Modes  
                Higher Order Modes
Weeks 2-3: Ray Tracing
   Ray Matrices
   Rays Analysis of Cavities
   Cavity Stability

Weeks 4-5: Resonant Optical Cavities
   General Cavity Concepts
   Gaussian Beams in Cavities
   Cavity Q and Finesse
   Photon Lifetime

Weeks 6-7: Atomic Radiation
   Blackbody Radiation
   Einstein’s A and B Coefficients
   Line Shape
   Amplification
   Line Broadening

Weeks 8-9: Laser Oscillation and Amplification
   Threshold Conditions
   Gain Saturation
   Amplified Spontaneous Emission

Weeks 11: General Characteristics of Lasers
   CW Lasers
   Laser Dynamics
   Mode Locking
   Saturable Absorbers

Weeks 12: Laser Excitation
   Three and Four Level Lasers
   Rare Earth Lasers
   Tunable Lasers

Weeks 13-14: Semiconductor Lasers
   Semiconductor Theory Review
   Diode Lasers
   Quantum Effects

15. Attendance and Expectations - Attendance is not required. Cell phones are to be silenced. No text messaging during class or exams.

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

16. Grading –
   10% - Homework (graded S/U)
   50% - Approximately 10 quizzes (lowest 2 grades are dropped)
   30% - Final exam
   10% - Attendance at graduate student presentations and a brief write up on one of the topics presented
17. **Grading Scale** - Grades will be curved.

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<tr>
<th>Grade</th>
<th>Score Range</th>
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<tr>
<td>A</td>
<td>94-100</td>
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<tr>
<td>A-</td>
<td>90-93</td>
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<tr>
<td>B+</td>
<td>87-89</td>
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<td>0-64</td>
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“A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: [https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx](https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx)

18. **Make-up Exam Policy** - Lowest quiz grade is dropped. Make-up quiz given only with an UF officially approved excuse.

If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed work. University attendance policies can be found at: [https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx](https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx)

Otherwise, make-up exams will be considered only in extraordinary cases, and must be taken before the scheduled exam. The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

19. **Honesty Policy** – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

“…failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.” [http://www.dso.ufl.edu/sccr/procedures/honorcode.php](http://www.dso.ufl.edu/sccr/procedures/honorcode.php)

20. **Accommodation for Students with Disabilities** – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will
provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. **UF Counseling Services** – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
   - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   - Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. **Software Use** – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.