**ELEG 587V: Introduction of Integrated Photonics, Spring 2017**

**TTh 9:30‐10:45 Location: CHPN0408**

**Instructor**: Dr. Shui‐Qing (Fisher) Yu Office: Nano 211 Phone: 575‐7265Email: syu@uark.edu

**Text book:**

There is no required textbook for this course. The instructor will distribute class notes to be used for teaching purpose.

**References:**

1. *“Silicon Photonics Design”* L. Chrostowski and M. Hochberg, Cambridge 2015

**Office Hours**: TTh 3:30pm‐4:30pm or any other time by prior email/phone appointment

**Goals:** This course is designed to provide junior and senior graduate students detailed knowledge of integrated photonics by using silicon photonics as an example. The course covers a cycle of design, fabrication, and testing of photonic devices by using analytic and numerical methods. The course will focus on designing an interferometer, which is widely used in communication and sensing applications. Students will be exposed to use the state‐of‐art design simulation tool, Lumerical, to design the photonic circuits and to evaluate the performances. In the course project, students will extend the design rules to design a set of components to be used for integrated microwave photonics based on Ge on Si, SiGeSn, or Si3N4 on sapphire platform.

**Prerequisites:** ELEG 4203 (Semiconductor Devices), ELEG 5353 (Semiconductor Optoelectronics) or other equivalent courses for students from other disciplines such as physics and materials. Please come to talk with the instructor to find out if you are eligible to take this course.

**Prerequisites by topics:**

1. Electromagnetic waves, quantum mechanics, and basics of solid state physics
2. Basic concepts of semiconductor devices
3. Numerical calculations and programming

**Grading Policy:**

Homework 30 points

Design and analysis 40 points

Final report 20 points

In class discussion 10 points

**Total 100 points**

**Standard Grades**

A (90% ‐ 100%), B (80% ‐ 89%), C (70% ‐ 79%), D (60% ‐ 69%), F (below 60%)

**Topics:**

**Introduction** (Course overview, background knowledge of silicon photonics, software setup/tutorial)

**Photonic Components** (waveguides, modeling, y-branch, waveguide bends, fibre grating coupler, advanced components)

**Photonic Circuits** (interferometer, modelling-Lumerical INTERCONNECT, design proposal)

**Layout design for fabrication** (KLayout, photonic circuits design)

**Design Review** (Review the design submitted)

**Fabrication** (E-beam lithography, manufacturing challenges)

**Measurement Data Analysis** (Practice measurement data, data analysis-MATLAB, fabrication Metrology, measurement data, measurement vs. simulation)

**Extended Materials** (TBD, optical I/O, modulators, detectors, lasers, system examples, and etc.)

**Final project** (Material selection, component selection, simulation and layout, report)

**ELEG 587V Teaching schedule**

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| --- | --- | --- |
| Week 1 | 1/17 | 1/19 |
|  | Introduction  Course overview, background knowledge of silicon photonics | software setup/tutorial |
| Week 2 | 1/24 | 1/26 |
|  | Photonic Components  waveguides | Modeling-Lumerical MODE |
| Week 3 | 1/31 | 2//2 |
|  | Y-branch | Waveguide bends |
| Week 4 | 2/7 | 2/9 |
|  | Fiber grating coupler | Advanced components |
| Week 5 | 2/14 | 2/16 |
|  | Layout design for fabrication (photonic circuits design, KLayout) | Practice photonic design |
| Week 6 | 2/21 | 2/23 |
|  | Photonic Circuits  Interferometer | Modelling-Lumerical INTERCONNECT |
| Week 7 | 2/28 | 3/2 |
|  | Design proposal | Layout design for fabrication |
| Week 8 | 3/7 | 3/9 |
|  | Layout-KLayout | Layout practice and submission |
| Week 9 | 3/14 | 3/16 |
|  | Design review concept | Review submission |
| Week 10 | 3/21 | 3/23 |
|  | Spring break | Spring break |
| Week 11 | 3/28 | 3/30 |
|  | Fabrication  Electron beam lithography | Manufacturing challenges |
| Week 12 | 4/4 | 4/6 |
|  | Measurement Data Analysis  Practice measurement data  Data analysis-MATLAB | Fabrication Metrology  Measurement data |
| Week 13 | 4/11 | 4/13 |
|  | Measurement Data  Measurement vs. Simulation | Final report |
| Week 14 | 4/18 | 4/20 |
|  | Extended material 1 | Extended material 2 |
| Week 15 | 4/25 | 4/27 |
|  | Final Exam |  |
| Week 16 | 5/2 | 5/4 |
|  |  |  |

5/5 Dead day