SHORT MODULES TARGETING JOB GROWTH & DEMAND

GARY BEASLEY, CENTRAL CAROLINA CC – NSF ATE LASER-TEC CO-PI

CHRYSANTHOS PANAYIOTOU, INDIAN RIVERS SC – NSF ATE LASER-TEC PI

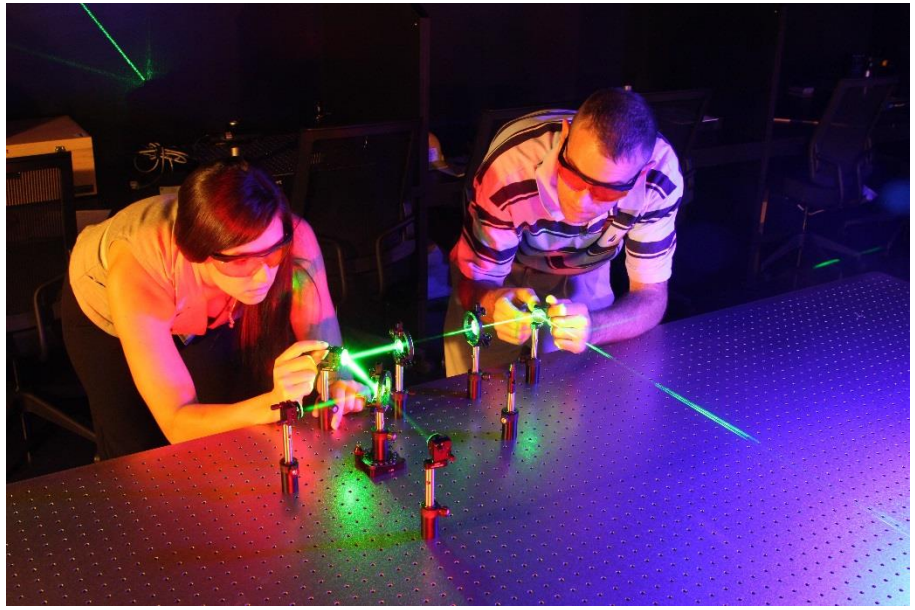
ABOUT LASER-TEC

- National Science Foundation Advanced Technological Center for Laser & Fiber Optics Education
- Association of community and state colleges, universities, high schools and technical centers, trade associations, and laser and fiber optic companies

36 PARTNER COLLEGES

LASER-TEC MISSION

Develop a sustainable pipeline of qualified laser & fiber optics technicians to meet the industry demand across the nation.



LASER-TEC GOALS

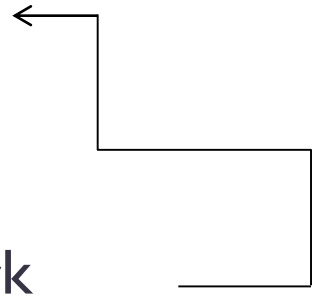
1. Increase and strengthen LFO academic programs to meet the industry demand.
2. Create and offer LFO professional development programs for secondary school teachers, college faculty, and incumbent workers.
3. Develop LFO curriculum materials for secondary schools, colleges, and industry.
4. Develop, promote, and deliver outreach and awareness programs to secondary STEM teachers, advisors, counselors, administrators, and the general public.
5. Develop strategies and materials for recruiting and retaining underrepresented groups and to promote diversity in LFO programs.

CCCC LASER PROGRAM BRIEF

- Established in 1987
- Located at the Lillington, NC Campus
- Two Year Associate Degree in Laser & Photonics Technology
  - 1st Year – Electronics Focus
  - 2nd Year – Photonics Focus
- LASER-TEC CO-PI

CCCC LPT PROGRAM FOCUS WITH LASER-TEC GRANT

- LASER-TEC Grant Focus at CCCC
  - Recruitment
    - Part-Time Recruiter
    - Laser Workshops
      - School Students, Teachers, and Educators
  - Preparation
    - New Course Development
    - Materials & Supplies
  - Placement
    - Strong Industry Partner Network



SHORT MODULES DEVELOPMENT HISTORY

- Idea suggested during CCCC Laser Program Fall 2013 Advisory Meeting.
  - Industry partners discussed the need for students to have a more detailed technical understanding of products and processes directly related to their industry.
  - Five to seven different industries, currently hiring students, are typically represented.
  - Discussed how the laser program curriculum was already full, without room for an additional course.

SHORT MODULES DEVELOPMENT HISTORY

- Committee suggested weekly modules
  - Industry focused
  - Industries hiring students
  - Basic technical understanding of industries' products and processes
- Committee suggested a "Photonics Applications" course for "Short Modules"
  - Semester long
  - Lab included
  - Members offered help in development/review content of modules

SHORT MODULES DEVELOPMENT HISTORY

- The curriculum already had a Photonics Applications course, during the fall semester of the second year.
  - Course was already loaded with curriculum material required for students to gain a strong basic understanding about laser fundamentals and brief applications of different laser types.

CCCC ORIGINAL LASER PROGRAM CURRICULUM

Laser Program Core Courses

- Intro to Elect Technology
- DC/AC Circuit Analysis
- Electronic Devices
- Digital Electronics
- Microprocessors
- Linear IC Applications
- SW for Technicians
- Troubleshooting
- Principles of Lasers
- Photonics Technology
- Photonics Applications
- Fiber Optics
- Photonics Project

Laser Program Other Courses

- Intro to Computers
- SPC
- Algebra/Trig I
- Algebra/Trig II
- Physics – Mechanics
- Expository Writing
- Research & Reporting
- Social Science
- Humanity

75 Total Hours

SHORT MODULES DEVELOPMENT HISTORY

- Advisors discussed companies hiring current CCCC laser program graduates
  - Cree – LED's
  - Wasatch & B&W Tek – Spectroscopy
  - Phononics – Thermal-Electric Devices
  - Synoptics/Northrop Grumman – Solid State Laser Crystal Growth
  - MegaWatt Lasers – High Energy Solid State Pulsed Lasers
- Recent company additions
  - Mazak & Disco America
  - LLNL
- Advisors suggested considering changing the "Fiber Optics" course to "Advanced Photonics Applications"
  - Though shortened, would still include a "Fiber Optics" Module
  - Modules focused on products, processes, and technology of companies, where the students would most likely be employed.

CCCC ORIGINAL LASER PROGRAM CURRICULUM

Laser Program Core Courses

- Intro to Elect Technology
- DC/AC Circuit Analysis
- Electronic Devices
- Digital Electronics
- Microprocessors
- Linear IC Applications
- SW for Technicians
- Troubleshooting
- Principles of Lasers
- Photonics Technology
- Photonics Applications
- Advanced Photonics Applications
- Photonics Project

New Course

Laser Program Other Courses

- Intro to Computers
- SPC
- Algebra/Trig I
- Algebra/Trig II
- Physics – Mechanics
- Expository Writing
- Research & Reporting
- Social Science
- Humanity

75 Total Hours

"ADVANCED PHOTONICS APPLICATIONS" COURSE

- Introduced in Spring 2016
- Seven Modules Included Fields of Study
  - Fiber Optics – 8 Week Module
  - Semiconductor Manufacturing – One Week Module Cree & Phononic Devices
  - LED Devices Manufacturing and Test – One Week Module Cree
  - Thermal Electric Devices Manufacturing and Test – One Week Module Phononic
  - Solid State Laser Crystal Manufacturing and Test – One Week Module Synoptics (NGC)
  - Field Service Engineering – One Week Module MAZAK & DISCO
  - High-Energy SS-Laser Design, Manufacturing & Test – One Week Module MegaWatt
  - Basic Spectroscopy – One Week Module Wasatch & B&W Tek
  - Advanced Spectroscopy – One Week Module Wasatch & B&W Tek

"ADVANCED PHOTONICS APPLICATIONS" COURSE

- Module General Contents
  - Weekly Reading Assignment
  - Weekly Homework
  - Weekly Lab
  - Weekly Test
- Fiber Optics Module Resource Material
  - Fiber Optics Communications Text Book

"ADVANCED PHOTONICS APPLICATIONS" COURSE

- Other Modules' Resource Material Sources
  - Semiconductor Manufacturing – NSF ATE MATEK Center Material and Internet Resources
  - LED Devices Manufacturing and Test – Internet Resources
  - Thermal Electric Devices Manufacturing and Test – Created and Internet Resources
  - Solid State Laser Crystal Manufacturing and Test – Created by Previous NGC Employee
  - Field Service Engineering – Created
  - High-Energy Solid-State Laser Design, Manufacturing and Test – Created by MegaWatt Technician/Previous CCCC Laser Student & MegaWatt Owner, Scott Hamlin
  - Basic Spectroscopy – NSF ATE OP-TEC Center Material
  - Advanced Spectroscopy – Created and Internet Resources

"SHORT MODULES" RESULTS

- Results
  - Student and Advisor Feedback has been very positive
  - Students are better able to make a career choice decision
    - Examples
      - Clean Room Environment
      - Large Company versus Big Company
      - Field Service Demands and Rewards

"SHORT MODULES" RESULTS

- Results
  - Students are better prepared when starting their career
    - Know Products, Processes and Lingo
    - Better understand some important Critical Success Factors and demands of different industries
    - Students may focus on an industry of their choice to better prepare
  - Advisors appreciative of their feedback being heard!
    - Advisor Ownership
    - More encouraged to Hire Graduates
    - More Advisor Involvement

"SHORT MODULES" RESULTS

- Advisor Module Involvement Important
  - Help Create Resource Material
  - Reviewed and suggested changes of all resource material
  - Helped with Lab Development
    - Provided suggestions for Labs
    - Donated Lab Material

"SEMICONDUCTOR MANUFACTURING" MODULE CONTENT

- This item contains resources the student will need to complete the module on "Semiconductor Manufacturing". The resources available in this item are:
- 1) A power point, "The Fabrication of a Microchip", which details examples of process steps used to make a CMOS integrated circuit.
- 2) A video, "CMOS Fabrication Video", which gives a pictorial view of process steps covered in the power point of "The Fabrication of a Microchip".
- 3) Power point number 2, "SMT", covering semiconductor manufacturing technology basics.
- 4) Power point number 3, "SMT101", covering semiconductor manufacturing technology basics from a different perspective.
- 5) An INTEL link that briefly describes how their "22nm" chip process.
- **The Making of a 22 nm Chip**
- http://www.intel.com/content/www/us/en/silicon-innovations/22nm-technology-how-transistors-are-made-video.html
- 6) An INTEL link that gives an animated tour of their "22nm" chip process.
- **Video Animation: Mark Bohr Gets Small: 22 nm Explained**
- http://www.intel.com/content/www/us/en/silicon-innovations/standards-22nm-explained-video.html

"LED MANUFACTURING & TEST" MODULE CONTENT

- This item contains resources the student will need to complete the module on "LED Characteristics and Testing". The resources available in this item are:
- 1) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Basics-of-LEDs_v1_09-01-10_SCRIPT", which details LED basics.
- 2) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Colorimetry_v1_07-11-11_SCRIPT", which details colorimetry basics.
- 3) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Electrical-Characteristics-of-LEDs_v1_03-07-11_SCRIPT", which details LED electrical characteristics basics.
- 4) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Mesopic_Vision_v1_4-2-141", which details mesopic vision basics.
- 5) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Optical_Principles_v3_11-16-12_SCRIPT", which details optical principles basics.
- 6) A power point, "OSRAM-OS_LED-FUNDAMENTALS_RadiometryPhotometry_v2_8-11-11_SCRIPT", which details radiometry photometry basics.
- 7) A power point, "OSRAM-OS_LED-FUNDAMENTALS_Thermal-Characteristics-of-LEDs_v2_08-16-11_SCRIPT", which details LED thermal characteristics basics.
- 8) A power point, "How-to-Read-a-Datasheet-Part-1-of-2-Typical-Maximum-Characteristics-and-Binning", which details part 1 of how to read an LED datasheet.
- 9) A power point, "How-to-Read-a-Datasheet-Part-2-of-2-Typical-Maximum-Characteristics-and-Binning", which details part 2 of how to read an LED datasheet.
- 10) A power point, "ELE432_Report_LED", which details basic semiconductor theory of how a LED operates.
- 11) A power point, "Cree LED Testing and Characterization", which explains the importance of proper LED testing, and how improper testing drives up product cost.
- 12) This links contains videos on all of the OSRAM powerpoints. This allows you to not only be able to read it, but also be able to watch as someone explains each point.
- http://ledlight.osram-os.com/knowledge/led-fundamentals/
- 13) Other LED educational links that may be useful.
- https://learn.sparkfun.com/tutorials/light-emitting-diodes-leds
- http://www.radio-electronics.com/info/data/semicond/leds-light-emitting-diodes/led-types.php

"TE MANUFACTURING & TEST" MODULE CONTENT

- This item contains resources the student will need to complete the module on "TE Characteristics and Testing". The resources available in this item are:
- 1) A power point, "Thermoelectric Coolers Basics", which details basics about Thermal Electric (TE) devices.
- 2) A power point, "Thermo-electric-modules", which details additional information about Thermal Electric (TE) devices.
- 3) Educational links that may be useful when learning about TE technology.
- http://tetech.com/faqs/
- http://www.tec-microsystems.com/EN/Intro_Thermoelectric_Coolers.html
-

"SOLID-STATE LASER CRYSTAL MANUFACTURING & TEST" CONTENT

- This item contains resources the student will need to complete the module on "Solid-State Laser Crystal Manufacturing and Test". The resources available in this item are:
- 1) A power point, "Solid-State Crystal Manufacturing", which details the process steps used to make solid-state crystals. These process steps are used by Synoptics to manufacturer crystals.
- 2) A pdf, "Solid-State Lasers - A Graduate Text", of a book on solid-state lasers written by professors at CREOL. Though this book was written for photonics graduate students, it still has a lot of very valuable information in it, which should be understood by a LEO 213 student in LPT. If one were considering working in the field of solid-state lasers, they are strongly encouraged to study this book in more detail, than required for LEO 213.
- 3) A pdf, "American Association of Crystal Growers-Talk 7-13-2-HydrothermalMultifunctionalCrystalGrowth", which provides additional information about solid-state crystal growth.
- 4) A pdf, "GB laser 50 years", which provides additional information about solid-state crystal growth.
- 5) A pdf, "Oxide Crystals for Solid State Laser Applications", which provides additional information about solid-state crystal growth.
- 6) Educational link that may be useful when learning about Solid-State Laser Crystal Manufacturing.
- http://www.repairfaq.org/sam/laserssl.htm

"FIELD SERVICE ENGINEERING" MODULE CONTENT

- This item contains resources the student will need to complete the module on "Field Service Engineering". The resources available in this item are:
- 1) A power point, "Field Service Engineering", which details some facts about a Field Service Engineering Career. This is becoming a very fast growing, lucrative career for laser and photonics technicians.
- 2) A pdf, "Field Services Engineer Job Description", which is a typical job description you may see posted for an open Field Service Engineering position for a company. These are not difficult to find!
- 3) Educational links that may be useful when considering a career in Field Service Engineering.
- http://study.com/articles/How_to_Become_a_Field_Service_Engineer.html
- http://study.com/articles/Electronic_Field_Service_Engineer_Job_Description_Duties_and_Requirements.html
- http://engineerontheroad.com/2012/11/24/field-service-engineering-good-bad/

“HIGH ENERGY PULSED SS LASER DESIGN” MODULE CONTENT

- This item contains a power point, "MegaWatt Lasers Project", which details content considered during the design of a high energy pulsed solid-state laser system. This resource will help the student to complete the module on "High Energy Pulsed Solid-State Laser Design and Test". This power point was created by Steven Coulbourne, while a CCCC laser program laser student. This was the result of Steven's final project, which was to go through the steps of designing a "High Energy Pulsed Solid-State Laser", with the help of Scott Hamlin, owner of MegaWatt Lasers in Hilton Head, South Carolina.

"BASIC SPECTROSCOPY" MODULE CONTENT

- This item contains a PDF, "Basics-of-Spectroscopy-10-25-07_SECURE.pdf". This PDF explains how spectroscopy is a science related to the emissions and absorptions of materials. One will learn how the electromagnetic spectrum may be used to probe atomic and molecular structures to identify substances in complex mixtures through something like a "fingerprint" analysis. The PDF will also review some of the equipment used to accomplish spectroscopy analysis today. This PDF was created by OP-TEC, the National Center for Photonics Education. OP-TEC is funded by a grant through the National Science Foundation (NSF). This resource will help the student to complete the module on "Basic Spectroscopy".

"ADVANCED SPECTROSCOPY" MODULE CONTENT

- This item contains resources the student will need to complete the module on "Advanced Spectroscopy". The information in the previous module, "Basic Spectroscopy", was more focused on understanding what spectroscopy was, and understanding the physics of it. It also spoke about how spectroscopy is used in general terms. There are many different types of spectroscopy, using many different types of energy sources to analyze the spectral characteristics of materials. Since the focus of our studies is light energy, we will only focus on three types of spectroscopy, which uses light energy as a source to analyze the spectral characteristics of materials. The three types are "Absorption", "Emission", and "Raman" Spectroscopy. This module, "Advanced Spectroscopy", is meant to guide you through resource material in order to gain an understanding of these types of spectroscopy. The resources available in this item are:
- 1) A pdf, "Spectroscopy-Introduction-and-Applications-EDU_Curriuculum_Guide", published by Ocean Optics, which is another manufacturer of light-based spectrometers. Focus on pages 8 through 20. Review this resource first.
- 2) A pdf, "BWTek Product Catalog 2014", published by B&W TEK, which is another manufacturer of light-based spectrometers. Focus on pages 34 and 35. Review this resource second.
- 3) A power-point, "2015 Raman GENERAL INFO WITH APPLICATIONS", published also by B&W TEK, which provides more detailed information on Raman spectroscopy. Focus on slide 4, and slides 8 through 18.
- 4) A video, "Scott Webinar HD", which discusses Raman Spectroscopy, using a Wasatch Photonics Spectrometer. The video was made by Dr. Scott Norton, when he was employed at Wasatch. Watch this video, after you have studies Raman Spectroscopy, and have a basic understanding of it.
- 5) Educational links that may be useful when learning about Advanced Spectroscopy.
- http://bwtek.com/spectrometer-introduction/
- http://bwtek.com/raman-introduction-to-raman-spectroscopy/

"LASER-TEC" MODULE TEMPLATE PART I

- **Module Title**

- **Introduction-motivation**
- [Give a compelling reason(s) for the need to know the knowledge presented in this module. Link it to modern day life and the need for a technical person to know the technology and concepts presented]
-
- **Learning Outcomes**
- After studying this module, you will be able to:
- Identify …
- Classify …
- Name …
- Develop …
- Analyze …
- List …
-

"LASER-TEC" MODULE TEMPLATE PART 2

- **Section 1** [The title of each section summarizes its content]
- **Sub-section (if needed)**
- **Self-Test** [Essay or Multiple choice questions with four choices and True – False ones]
- **Section 2**
- **Self-Test**
- **Section 3**
- **Self-Test**
- **Module Summary/Glossary** [Bullet points of the important points of each section]

"LASER-TEC" MODULE TEMPLATE PART 3

- Module Review Questions [Additional questions for reader to cover all topics of the module. Questions asking the reader to do further search and study of the subject on the www]

- Answers to Self-Tests

1. A 5. D
2. C 6. F
3. B
4. T

- Bibliography
-

END OF PRESENTATION

Thanks!

And

Questions?

CONTACT INFORMATION

Gary Beasley
Lead Instructor
Co-PI LASER-TEC
gbeasley@cccc.edu
(910) 814-8828

Dr. Chrys A. Panayiotou
Professor and Chair
PI LASER-TEC
cpanayio@irsc.edu
(772) 462-7621