

PHOTONICS TECHNOLOGY

School of Applied Technologies

Contact Information: Program information is available from the School of Applied Technologies Office at (505) 224-3340 or from Academic Advisement and Career Development at (505) 224-4321

- Associate of Applied Science Degree in Photonics Technology
- Post Degree Certificate of Completion in Photonics Technology

PROGRAM DESCRIPTION

The program is designed to expose students to four major areas: laser systems, electronics, optics and electro-optics. Students study the laser both as an instrument and as an integral part of a system designed for industrial and scientific applications. The program includes topics such as laser alignment, safety and the use of lasers in electronics production, testing and maintenance. Through the program, students acquire a good working knowledge of light, optical principles, and optical components and systems. In addition, students receive in-depth classroom preparation in the scientific principles of laser and fiber optics to incorporate their skills and knowledge into developing electro-optical techniques and systems. The post degree certificate is designed for those who already possess the core Electronics Technology associate's degree or a degree in a related technical field from an accredited college or university.

SPECIAL REQUIREMENTS

Students must have normal color differentiation to work with colored lasers, wiring and components.

CAREER AND EDUCATIONAL OPPORTUNITIES

The national demand for photonics technician exceeds supply. Graduates will be eligible for entry-level technical positions in a wide range of scientific disciplines utilizing laser and electro-optic technology.

Exit competencies for this program of study are available at cnm.edu/exitcomp.

For the graduation policy refer to page 46 of the 2009-2011 Catalog, cnm.edu or the Students tab in myCNM.

COURSE PREREQUISITE(S)

COURSE	ACCUPLACER SCORE OR EQUIV.
ENG 0950 Essay Writing.....	85
MATH 0940 Algebraic Problem Solving II or Elementary Algebra score of.....	81
RDG 0950 Reading and Critical Thinking.....	80

Students should see an academic advisor to customize their educational plans. Students must meet prerequisites by placement scores or specific course work. Please see Course Descriptions for prerequisite(s) information.

See page 12 of the 2009 Catalog for Accuplacer score equivalencies.

Post Degree Certificate

Students must have completed the Electronics Technology associate's degree or a bachelor's degree in a related field from a regionally accredited college or university, and obtain department approval to pursue the Post Degree Certificate of Completion in Photonics Technology.

RECOMMENDED COURSE SEQUENCE

TERM 1

ELEC 1002 Survey of Adv. Technologies Career Pathways.....	1
ELEC 1004 DC and AC Circuits.....	4
ELEC 1092 DC and AC Circuits Lab.....	2
ELEC 1010 Electronics Math.....	4
ENG 1101 (or 1102) College Writing.....	3

TERM 2

ELEC 1101 Digital Circuits Concepts & Design.....	3
ELEC 1192 Digital Circuits Concepts & Design Lab.....	2
ELEC 1201 Semiconductor/Solid State Devices	4
ELEC 1292 Semiconductor/Solid State Devices Lab	2
Humanities or Social/Behavioral Science Elective.....	3

TERM 3

ELEC 1301 Electromechanical Devices & Systems.....	3
ELEC 1392 Electromechanical Devices & Systems Lab	4
MATH 1310 (or higher) Intermediate Algebra.....	3-4
ENG 1119 (or 2219) Technical Communications	3

Certificate in Electronics Technology.....41-42

TERM 4

PHOT 1001 Intro to Photonics & Photonics Safety.....	4
PHOT 2001 Optics.....	6
PHOT 2005 Intro to Laser Systems.....	4
PC 2020 Vacuum Systems.....	2

TERM 5

PHOT 1010 Fiber Optics.....	3
PHOT 2020 Adv. Laser Systems.....	6
PHOT 2999 Capstone	3
BIO Science Lecture/Lab	4
Or	
CHEM Science Lecture/Lab	4
Or	
PHYS Science Lecture/Lab	4-5

Associate of Applied Science in Photonics Technology...73-75

RECOMMENDED COURSE SEQUENCE – POST DEGREE CERTIFICATE

TERM 1

PHOT 1001 Intro to Photonics & Photonics Safety	4
PHOT 2001 Optics	6
PHOT 2005 Intro to Laser Systems.....	4
PC 2020 Vacuum Systems.....	2

TERM 2

PHOT 1010 Fiber Optics.....	3
PHOT 2020 Adv. Laser Systems	6
PHOT 2999 Capstone	3
BIO Science Lecture/Lab	4
Or	
CHEM Science Lecture/Lab.....	4
Or	
PHYS Science Lecture/Lab	4-5

Post Degree Certificate in Photonics Technology.....32-33

Course Subject Code/Course Number – Course Name Credit Hours

ELEC – Electronics

ELEC 1002 – Survey of Adv. Technologies Career Pathways 1

Overview of the Advanced/Emerging Technologies Industry: Sectors, Jobs, Technology and Trends.

ELEC 1004 – DC and AC Circuits 4

(Pre- or corequisite: ELEC 1010 + ELEC 1092)

This course covers the basic concepts of DC and AC electronics with emphasis on Ohm’s Law, Kirchhoff’s Law, power, magnetism and electromagnetism, with emphasis on circuit analysis, component application and troubleshooting. Construct circuits from schematic diagrams and use of multimeters, oscilloscopes, function generators and power supplies in the lab to support concepts taught in class. Introduction and use of circuit simulation software (Multisim®) to build, simulate, test, and troubleshoot fundamental electronic circuits.

ELEC 1010 – Electronics Mathematics 4

(Prerequisite: MATH 0940 or appropriate placement score, see page 12 of the CNM Catalog.)

Includes selected topics from algebra, geometry and trigonometry that support the technologies programs. Also includes metric conversions, simultaneous linear equations, complex numbers, the impedance triangle and exponential and logarithmic functions.

ELEC 1022 – Soldering Standards 2

Industry standard soldering techniques for high reliability connections. Soldering certification is covered. (15 theory + 45 lab hours per term)

ELEC 1092 – DC and AC Circuits Lab 2

(Pre- or corequisite: ELEC 1004)

Laboratory exercises designed to reinforce the concepts from ELEC 1004. (90 lab hours per term)

ELEC 1101 – Digital Circuit Concepts & Design 3

(Corequisite: ELEC 1192)

Covers the fundamentals of Digital logic and FPGAs. Building/troubleshooting digital electronics devices and circuits with emphasis on components using the FPGA and VHDL coding. Project Design, Synthesis, Behavioral Simulation, and Configuration of Hardware Devices are the main processes of the class to program digital gates, combinational logic circuits, and basic digital devices (counters, shift registers, DAC, etc.)

2009-11 CNM Catalog Addendum

ELEC 1192 – Digital Circuit Concepts & Design Lab 2
(Corequisite: ELEC 1101)
Laboratory exercise designed to reinforce the concepts from ELEC 1101. (90 lab hours per term)

ELEC – 1201 Semiconductor/Solid State Devices 4
(Prerequisite: ELEC 1004 + ELEC 1010 + ELEC 1092. Corequisite: ELEC 1292)
This course will cover the following components/devices and their applications: Diodes, Transistors, Operational Amplifiers, MOSFETs, Integrated Circuits, Switching Power Supplies, DC-DC Converters, Inverters. Includes measurement, conversion/control, troubleshooting electronic circuits with emphasis on Integrated Circuits.

ELEC 1292 – Semiconductor/Solid State Devices Lab 2
(Corequisite: ELEC 1201)
Laboratory exercise designed to reinforce the concepts from ELEC 1201. (90 lab hours per term)

ELEC 1301 – Electromechanical Devices & Systems 3
(Prerequisite: ELEC 1201 + ELEC 1292. Corequisite: ELEC 1392)
Presents theory and application of mechanical devices and their control circuits. Includes hydraulics, pneumatics, PLCs, AC and DC and VFD motors, stepper motors and servomechanisms. Students design, assemble, operate and troubleshoot electromechanical systems.

ELEC 1392 – Electromechanical Devices & Systems Lab 4
(Pre- or corequisite: ELEC 1301)
Laboratory exercise designed to reinforce the concepts from ELEC 1301. (180 lab hours per term)

ELEC 1401 – Telecommunications Circuits & Systems 3
(Prerequisite: ELEC 1201 + ELEC 1301. Corequisite: ELEC 1492)
This course covers tuned amplifiers, oscillators, optoelectronic devices, AM/FM & Single-Sideband communications. Coding techniques, Transmission lines, Antennas, Waveguides and RADAR, Television.

ELEC 1492 – Telecommunications Circuits & Systems Lab 2
(Corequisite: ELEC 1401)
Laboratory exercise designed to reinforce the concepts from ELEC 1401. (90 lab hours per term)

ELEC 2010 – Intro. to Embedded Systems – Microcontrollers 4
(Prerequisite: ELEC 1301 + ELEC 1392)
Focuses on programming an embedded system in a Windows environment. Programs written in assembly language are assembled to process instructions and data for controlling various I/O functions. Emphasis is given to a final I/O project involving input sensors (transducers), A/D converters, D/A converters and output devices (actuators). (30 theory + 90 lab hours per term)

ELEC 2040 – Systems Simulation 3
(Prerequisite: ELEC 1301 + ELEC 1392 + ELEC 2010)
Electronics Test Equipment and Systems, Block Diagram & Signal Flow Analysis. Use of Simulation Software to teach design and troubleshooting. (30 theory + 45 lab hours per term)

ELEC 2999 – Capstone 2
(Prerequisite: ELEC 1401 + ELEC 1492 + ELEC 2010)
Capstone projects course. (15 theory + 45 lab hours per term)

MEMS – Micro-Electro-Mechanical Systems

MEMS 1001 – Intro to MEMS 3

Covers the theory, construction methods, terminology and application of this emerging field. MEMS, micro-machines and nanotechnology covers devices and systems ranging from DMDs (Digital Mirror Devices) used in Internet and communications switching systems, nano-inductors used in RF systems to biomedical “lab on a chip” systems which draw samples, via nanopumps, to identify sample components via infrared spectroscopy. (30 theory + 45 lab hours per term)

MEMS 2001 – Manufacturing Process 5
(Prerequisite: MEMS 1001 + ELEC 1010; or department approval)
Covers the various construction methods used to manufacture MEMS components and systems. Bulk micro-machining, surface micro-machining processes such as SUMMIT IV, MUMPS will be covered in detail. (45 Theory + 90 Lab hours per term)

MEMS 2005 – MEMS Design 1 3
(Prerequisite: MEMS 1001. Corequisite: MEMS 2001)
Introduces MEMS design techniques and standards via MEMS CAD software. Students will design simple MEMS components using industrial and research MEMS software. (30 theory + 45 lab hours per term)

MEMS 2015 – MEMS Manufacturing Technology Theory 3
(Prerequisite: SMT 2001 + SMT 2092)
Introduces Micro Electro-Mechanical Systems manufacturing including the basics of MEMS materials and devices, MEMS systems, clean room technology and topics in wafer processing.

MEMS 2092 – MEMS Manufacturing Technology Lab 2
(Prerequisite: SMT 2001 + SMT 2092)
Provides lab course for MEMS 2015. Laboratory exercises conducted in a clean room. (90 lab hours per term)

MT – Manufacturing Technology

MT 2005 – Statistical Controls 3
(Prerequisite: MATH 0940 or appropriate placement scores, see page 12 of the CNM Catalog)
Features the use of hardware and software as they apply to quality assurance. Study design of experiments, sampling techniques, SPC, control chart application and development and process reliability. (30 theory + 45 lab hours per term)

PC – Process Control

PC 2015 – Power RF

2

(Prerequisite: ELEC 2001 or ELEC 1201; ELEC 1292)

Presents RF energy and its applications in manufacturing industries. Includes plasma physics, RF applications, safety, RF generators, transmission lines and RF interference. (15 theory + 45 lab hours per term)

PC 2020 – Vacuum Systems

2

(Prerequisite: ELEC 2005 or ELEC 1301; ELEC 1392)

Introduces vacuum technology and vacuum systems. Includes gas laws and properties, operation and applications of vacuum pumps, gauges and valves and systems leak detection. (15 theory + 45 lab hours per term)

PHOT – Photonics

PHOT 1001 – Intro to Photonics & Photonics Safety

4

(Prerequisite: MATH 0940 or appropriate placement scores, see page 12 of the CNM Catalog)

Introduces fiber optics and light theory including the basics of laser safety and operation. This course presents the elements of fiber optics including: theory and operation of fiber optics, handling of fiber optics, integrated optics, waveguide transmission and fiber optic components. Light propagation topics are introduced. Safety procedures concerning lasers and related equipment are presented in this course. (45 theory + 45 lab hours per term)

in the near and far field; and the operation of such devices as gratings and quarter-wave plates. It also covers wave length, dispersion and refractive index measurements and the concept of modulation transfer function.

(60 theory + 90 lab hours per term)

PHOT 2005 – Intro to Laser Systems

4

(Prerequisite: ELEC 1004 + ELEC 1092. Pre- or corequisite: PHOT 2001)

Introduces the theory and operation of solid-state and gas lasers and presents continuous wave and pulsed systems. The course covers laser power and energy measurements, power supplies, cooling systems and safe operation of class 4 lasers. Hands on operation and alignment are emphasized. (15 theory + 135 lab hours per term)

PHOT 1010 – Fiber Optics

3

(Prerequisite: PHOT 1001)

Presents optical wave-guides and fibers as well as Fiber Optics Telecommunication. The course covers basic fiber optics components and active devices such detectors for fiber optic systems, isolators, attenuators, circulators, couplers, cables, connectors, switches, pump lasers, transmission systems and repeaters. (15 Theory + 90 Lab hours per term)

PHOT 2020 – Advanced Laser Systems

6

(Prerequisite: PHOT 2005)

Covers the applications of laser Systems to industry. Include laboratory experiences such as calibration techniques, interferometry, Q-switching. The course requires the student to write a technical paper. (60 theory + 90 lab hours per term)

PHOT 2001 – Optics

6

(Pre- or corequisite: PHOT 1001)

Presents basic geometrical (ray) and physical (wave) optics. The course covers the basics of the light reflection and refraction and the use of simple optical elements. It reviews light wave interference, diffraction and polarization; the use of thin film coatings on mirrors; laser beam divergence

PHOT 2999 – Capstone

3

(Pre- or corequisite: PHOT 2020)

Capstone projects course. (135 Lab hours per term)

SMT – Semiconductor Manufacturing

SMT 2001 – Manufacturing Technology Theory

3

(Prerequisite: ELEC 1004 + ELEC 1092 + ELEC 1101+ ELEC 1192.

Corequisite: SMT 2092)

Introduces integrated circuit manufacturing, including the basics of semiconductor materials and devices, integrated circuits, clean room technology and topics in wafer processing. Laboratory exercises are conducted in a clean room.

SMT 2092 – Manufacturing Technology Lab

2

(Corequisite: SMT 2001)

Provides a lab course for SMT 2001. (90 lab hours per term)