

# COURSE OUTLINE

## PHOT-200 Principles of Lasers 3 Semester Hours

### HOWARD COMMUNITY COLLEGE

#### Description

This course covers the basic principles of laser operations and applications with particular emphasis on laser safety. Beginning with an introduction to incoherent and coherent light sources, the structure of the atom, emission processes, and stimulated emission of radiation will be studied. Next, laser output characteristics and modification, laser materials and components, and common types of industrial lasers will be studied. Included is an overview of major industrial laser applications (e.g. Telecommunications). Safety and laboratory procedures are also covered. The lab experiments will closely follow, reinforce, and extend the classroom material. Prerequisites: MATH-131 or higher and PHOT-105. (2 hours lecture, 3 hours lab)

#### Overall Course Objectives

Upon completion of this course, the student will be able to:

1. Describe the basic principles of physics, physiology, electronics, and photonics related to the understanding of the basic principles of lasers, laser safety, and laser applications.
2. Demonstrate familiarity with general terminology and materials used in the field of lasers.
3. Apply principles and math equations to solve elementary problems related to lasers.
4. Identify and discuss the basic principles of laser operations such as coherent light, lasing action, laser elements, output characteristics, application properties, etc.
5. Explain and identify the structure, operation, beam development, longitudinal frequency and spatial beam modes, cavity properties, and wavelengths using a Helium-Neon laser as a case study.
6. Discuss, classify, and identify practical applications of the different types of lasers studied.
7. Explain and apply the principles of laser safety as embodied in the American National Standards Institute (ANSI) Standards.
8. Discuss and interpret contemporary applications of lasers found in print and non-print media plus on the Internet.
9. Write (using correct data collection, organization, and analysis techniques) a complete formal lab report (written utilizing proper grammar techniques) to include: title of experiment, objectives, data and observations, results and conclusions.
10. Develop skill in performing elementary experiments related to understanding the principles and operation of lasers to obtain satisfactory results and form correct scientific conclusions.
11. Operate HeNe lasers, optical power meters and other devices related to lasers in a safe manner.
12. Perform accurate measurements using the laser and related electro-optic systems and equipment.

## **Major Topics**

- I. Principles of Light for Understanding Lasers
  - A. Light and Wave Terminology
  - B. Incoherent Light Sources
  - C. Atomic Structure
  - D. Emission and Absorption of Light
  
- II. Basics of Laser Operations
  - A. Coherent Light and Lasing Action
  - B. Laser Elements and Beam Properties
  - C. Optical Cavities and Modes of Oscillation
  - D. Temporal and Spatial Characteristics of Lasers
  - E. Laser Application Properties (e.g. collimation, intensity and radiance, focus ability, etc.)
  
- III. Laser Safety
  - A. Physiological Effects
  - B. Laser Exposure Levels
  - C. Non-Beam Hazards (i.e. optical, electrical, thermal (heat) and chemical)
  - D. Laser Safety Standards and Safety Classifications (ANSI)
  - E. Common Causes of Accidents and Control Measures
  
- IV. Power and Energy of Laser Outputs
  - A. Spot Size Effects
  - B. Transmission Losses through Optical Paths
  - C. Theory and Operation of Optical Power Meter
  
- V. Helium-Neon Gas Laser - A Case Study
  - A. Laser Structure
  - B. Laser Operation
  - C. Laser Beam Development
  - D. Longitudinal Frequency Modes
  - E. Transverse Spatial Beam Modes
  - F. Laser Cavity Properties
  - G. HeNE Laser Wavelengths

## **Course Requirements**

Grading/exams: Grading procedures will be determined by the individual faculty member, but will be calculated on the basis of exams, quizzes, homework problems and lab reports (including two formal labs). This course includes a final exam.

Writing: Specific writing assignments will be determined by the individual faculty member, but will include lab reports and a few short answer and essay questions on quizzes and exams.

## **Other Course Information**

This course is required for the Photonics Technology Program.