LU1: LAB 1-3E: Optical Photometer Use and Stability

REFERENCES:

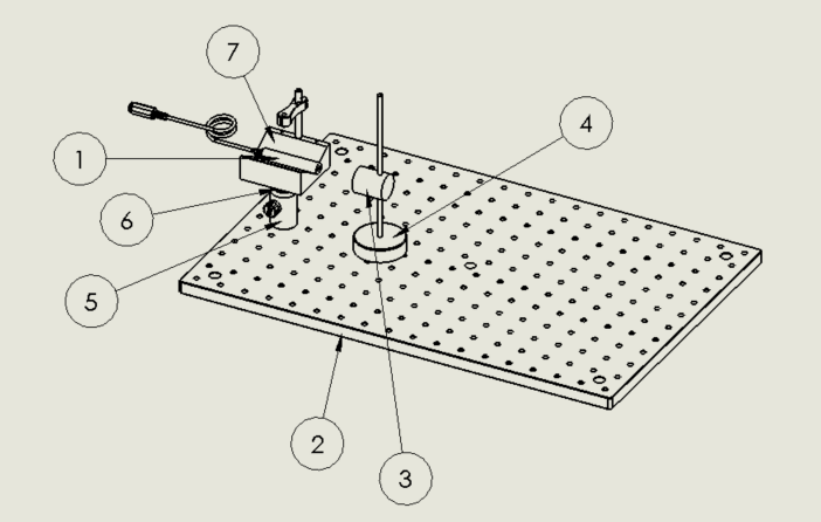
- *Fundamentals of Light & Lasers* (OPTEC), 2nd edition
- Module 3, Laboratory 1-3E, pages 39 -42.
- http://optecvideo.opteccrm.org, Video 12.
  - Course 1: Fundamentals of Light and Lasers
  - Lab Activity Video
  - Choose Video #

THEORY: A Photometer or optical power meter is used to measure the power of a laser beam or other electromagnetic radiation source. Erroneous results can result from improper use or an incomplete understanding of the meter. An understanding of the meter capabilities is also needed to choose a meter and detector/sensor that are appropriate for the application. An uninformed choice can result in damage to the device or compromised data collection.

OBJECTIVE: Become familiar with the photometer (optical power meter) and its use.

EQUIPMENT:

- Laser Diode Module (key 1)
- Laser Diode Power Supply
- Optical Breadboard (key 2)
- Photometer, Detector (key 3)
- Stand, Photometer Detector (key 4)
- User's Manual for Digital Photometer
- Post Holder (key 5)
- Post (key 6)
- V-Clamp (key 7)
- Misc. Hardware



SET-UP: Read the entire SET-UP and PROCEDURE before starting the lab.

1. Mount a post holder near the center of a short end of the breadboard.
2. Attach a post to the center hole in the bottom of the V-clamp.
3. Insert the V-clamp assembly in the post holder.
4. Place a non-reflecting object at the end of the board opposite the post holder to contain the laser beam.
5. Mount the laser diode in the V-clamp.
   a. Position it to project a beam along the length of the breadboard. (The photometer detector/sensor will be positioned in the beam later)

PROCEDURE (Part 1): Use the Operator's Manual for the Photometer to answer the following questions. **Include both question and answer in the Lab Write-Up.**

1. Who is the manufacturer of the photometer?
2. What is its Model Number?
3. What kind of power supply is used and what is the input voltage?
4. Describe the detector/sensor.
5. Over what range of wavelengths will the photometer detector work?
6. How large is the detector active area?
7. What is the minimum to maximum laser power input?
8. What would happen if you exceed the maximum laser power input by a small amount?
9. What might happen if you exceed the maximum laser power input by an excessive, amount?
10. What does it mean to "zero" the meter?
11. When should you zero the meter?
12. What is the purpose of the "+V" and "-V" jacks?
13. What is the digital resolution of the LCD?
14. What is the purpose of the detector housing?

PROCEDURE (Part 2): Follow the operating procedures on page 8 of the photometer operator's manual to take measurements of the kit flashlight and laser diode.

1. Mount & position flashlight directly in front of and touching the detector housing.
2. Repeat with the laser diode.
3. **In the Lab Write-Up, record the power readings in a table like the one below**.

Flashlight Power Reading in mW. Power flashlight = P_{fl}	Laser Diode Power Reading in mW Power laser diode = P_{ld}	% Difference: $[(P_{fl} - P_{ld}) / P_{fl}]$x 100 =
P_{fl} = _____ mW	P_{ld} = _____ mW	_____% Difference

4. Is this what you expected? **Please explain/analyze your answer in the Lab Write-Up.**

CALCULATION (Part 2): Calculate the % (per cent) difference between the flashlight and laser power readings and enter the result in the chart. **All calculations are to be included in Lab Write-Up, showing the equation and answer obtained**.

1. % Difference = (Flashlight Power Reading – Laser Power Reading)/Flashlight Power Reading) (100)).
    a. Example: %Difference = (2.5mW – 1.4mW)/2.5mW
    b. 1.1mW/2.5mW = .44
    c. .44 x 100 = 44%
    d. %Difference = 44
2. Discuss/compare/explain the differences **in the Lab Write-Up**.

PROCEDURE (Part 3):

1. Mount the photometer detector on the stand supplied with the photometer.
2. Turn on the laser (make sure a laser beam block is in place to contain the beam).
3. Place the photometer detector in the laser beam path & align it with the center of the small hole in the sensor.
4. Set the range on the photometer to the highest range.
5. Push and hold the on/off switch to read the laser power.
    a. Turn the range switch to the lowest, most sensitive range without overload per the manual.
6. Now that the set-up is ready, keep the laser and photometer off for 5 minutes to stabilize to ambient conditions.
7. Turn on laser.
    a. Immediately begin to measure power and record in table.
    b. Record the power level reading in 10 second intervals.
    c. Log readings until they stabilize (five consecutive unchanged readings).
    d. **In the Lab Write-Up, record the power readings in a table like the one below**.
8. What would be a reasonable warm-up time recommendation for the diode laser?
9.

Laser Stability:

Time Elapsed	Reading (mW)
Start	
10 sec	
20 sec	
30 sec	
40 sec	
50 sec	
1 min	
1 min 10 sec	
1 min 20 sec	
1 min 30 sec	
1 min 40 sec	

DISCUSSION:

- Power meters (photometers) used with lasers often use a photosensitive detector for lower powers and a thermal detector for higher powers. Higher powers will damage a photosensitive detector.
- Power meters with a wavelength setting must be configured to the correct wavelength for an accurate reading
- Power stability (+/- a specified percentage) is often a specification for a laser.
- A warm-up period is usually specified as well as a window of time over which the stability is tracked.