Experiment - 6: Light Source Characteristic

Date: -

1. **Aim:** a) Plot the V-I characteristics for 1310nm Laser source for the CW.
   b) Plot the V-I characteristics for LED source for the CW.

2. **Requirements:** Link-B,Link-F kit with power supply, DMM, 1 Meter single mode fiber patch cord, Glass fiber

3. Pre Experiment Exercise:

Brief Theory

The sources currently used with fiber optics are semiconductor light sources, either light-emitting diodes or semiconductor lasers. These sources have a combination of usable properties in size, wavelength availability, power, linearity, simplicity of modulation, low cost, and reliability that make them suitable for this application. Two commonly used sources for optical communication are LEDs and LASERs.

Laser diodes and light emitting diodes have a number of elements in common with respect to their theory of operation. However the laser diode theory of operation incorporates more elements, taking in additional processes to provide coherent light.

LEDs work on the principle of spontaneous emission while LASER works on the principle of stimulated emission. Additional a Fabry perot cavity is used in LASER is order to provide optical confinement leading to continuous stimulated emission. From Fig 1, which presents the PI characteristics of LED and LASER, it can be seen that stimulated emission begins after a particular threshold for current density is reached leading to sharp increase in power as compared to the increase in power before the threshold.

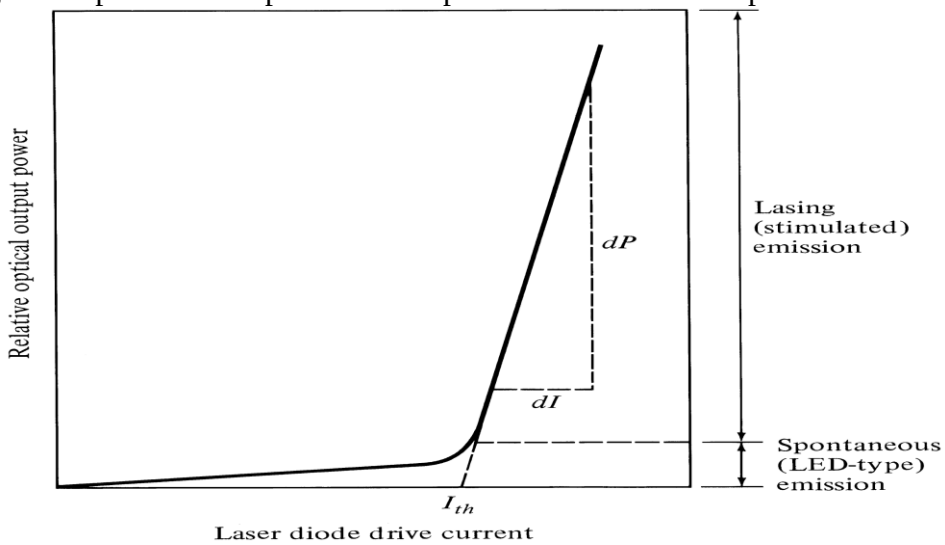

Fig. 1: Optical ouput versus drive current

Types of sources in both LED and LASER are dependent on various parameters like material structure or light output. In terms of light output two available configurations are surface emitters and edge emitters. In terms of material, a double heterojunction structure (i.e. different material configuration on both sides of active region) is preferred as it provides both optical and carrier confinement in the active region.

LEDs are typically suitable for systems using multimode fibers requiring less than 50 Mbps of information rate whereas LASERs are typically used with single mode fibers in systems with data rates in excess of 20 Gbps.

4. Procedure

1) V-I characteristics for 1310nm Laser source (using Link-F kit):-

   - Refer to 1a and carry out the connections. Make sure that the power supply of Link-F is off.
   - Keep intensity control pot POT1 fully anticlockwise.
   - Keep jumper J6 to VI/IP.
   - Connect voltmeter between jumper JP2 with respective polarity, which indicates voltage across the laser.
   - Connect voltmeter between jumper JP4 with respective polarity, which indicates current through LASER in terms of voltage.*For current measurement, we are actually measuring the voltage across 1E resistor and by using OHMs law V=IR, we can directly get current flowing through laser. E.g. the voltmeter reads 50mV then it corresponds to 50 mA current.
   - Turn the Intensity control pot slightly in the clockwise direction.
   - Record the current in mA and the corresponding voltage in volts.
   - Repeat the procedure for current readings up to the 45 mA.
   - Plot the graph for current (mA) vs voltage (V).
   - Find out the threshold current (Ith) in mA from the I-V graph.

2) V-I characteristics for LED source (Link- B kit):-

   - Make connections as shown in fig. Connect the power supply cables with proper polarity to Link-B kit. While connecting this, ensure that the power supply is OFF.
   - Keep switch SW8 towards VI position. Keep switch SW9 towards TX1 position. Keep jumper JP8 towards sine position.
   - Keep bias control pot P1 towards maximum position & P2 towards minimum position.
   - Insert the jumper to crocodile connecting wires in jumper JP5, JP6, JP9, JP10 at positions shown in the fig.
   - Connect the voltmeter & current meter with proper polarity to above mentioned jumpers.
   - Switch on the power supply.
   - Slightly unscrew the cap of SFH756 (660nm). Do not remove the cap from the connector. Once the cap is loosened, insert the 1 meter. Fiber into the cap. Now tighten the cap by screwing it back.
   - Connect the other end of the fiber to detector SFH350V (Photo transistor detector) very carefully as per the instructions in above step.
   - Vary intensity control pot P2 to control current flowing through the LED.
   - Rotate P2 slowly & measure forward current & corresponding forward voltage

5. Observations:

V-I Characteristics for 1310nm LASER source	
V	I

V-I Characteristics for LED source	
V	I

6. Conclusion/Comments:

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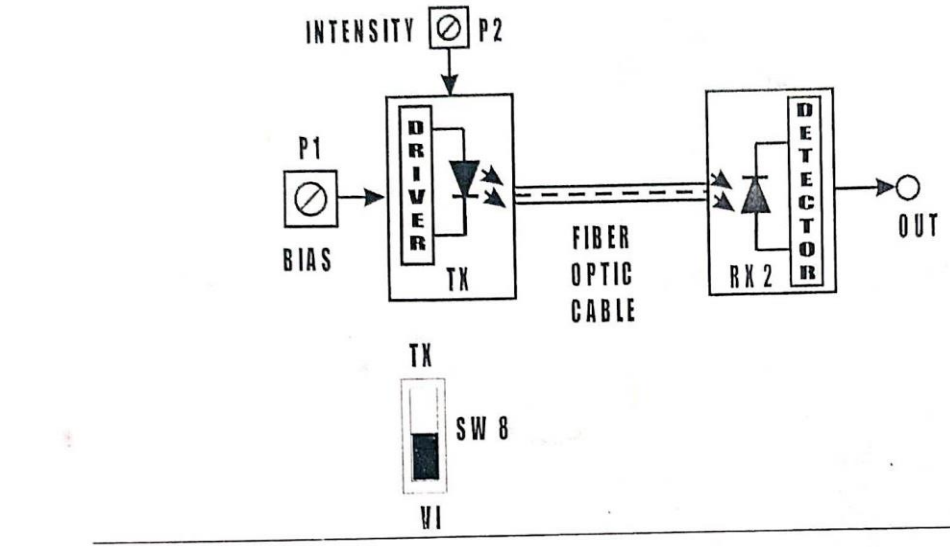
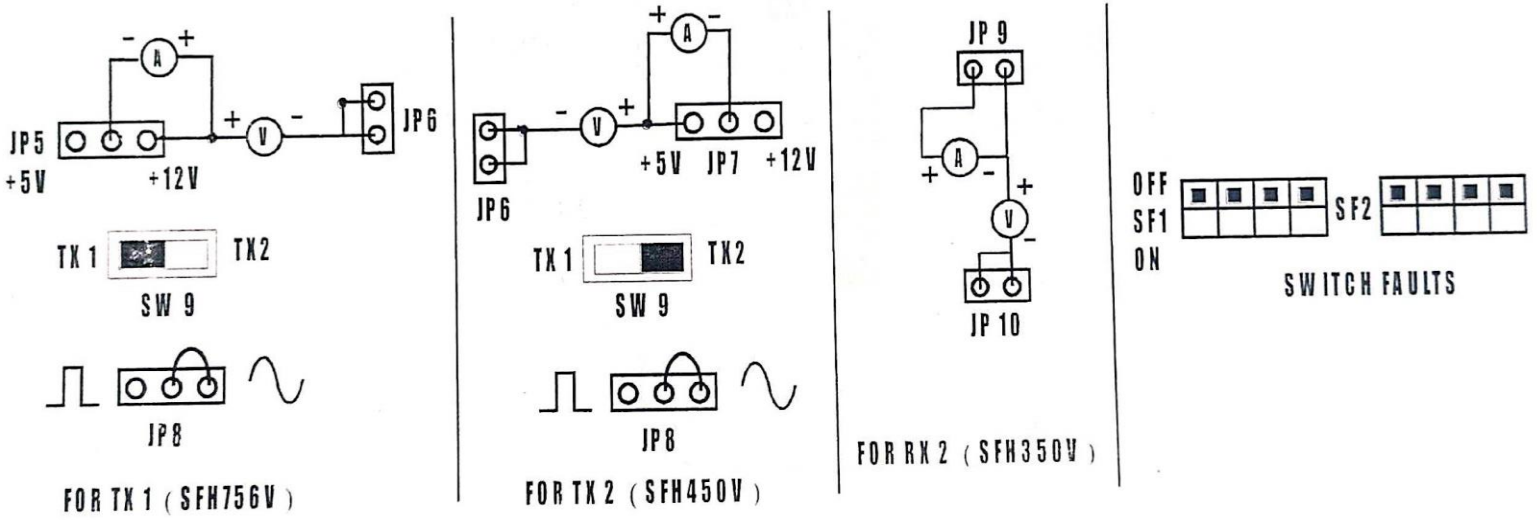
7. Questions

1. Compare the SLED with ELED in tabular format.
2. Compare LED and LASER in tabular format.
3. The power generated internally within a double-heterojunction LED is 28.4 mW at a drive current of 60 mA. Determine the peak emission wavelength from the device when the radiative and non-radiative recombination lifetimes of the minority carriers in the active region are equal.
4. The longitudinal modes of a gallium arsenide injection laser emitting at a wavelength of 0.87 μm are separated in frequency by 278 GHz. Determine the length of the optical cavity and the number of longitudinal modes emitted. The refractive index of gallium arsenide is 3.6


INTENSITY
P2
P1
BIAS
DRIVER
TX
FIBER
OPTIC
CABLE
RX 2
DETECTOR
OUT
TX
SW 8
VI


JP5
+5V
+12V
JP6
TX 1
TX2
SW 9
JP8
FOR TX 1 (SFH756V)
JP6
+5V
JP7
+12V
TX 1
TX2
SW 9
JP8
FOR TX 2 (SFH450V)
JP 9
JP 10
FOR RX 2 (SFH350V)
OFF
SF1
ON
SF2
SWITCH FAULTS