EXPERIMENT - 2

LOSSES IN OPTICAL FIBERS

OBJECTIVES:

- To study various types of losses that, occur in optical FIBERs and measure the loss in dB of two optical FIBER patchcords.

BASIC DEFINITIONS:

Attenuation in an optical FIBER is a result of a number of effects. This aspect is well covered in the books referred to. We will confine our study to attenuation in a FIBER due to macro bending and estimate the losses in two patchcords. Preferably we will use patchcords of two different lengths.

The loss as a function of the length of the FIBER is measurable only when we use a Meter cable too in the experiments. FIBER loss variations with wavelength for the MMA FIBER under consideration are16 shown in appendix-1.

The optical power at a distance, L, in an optical FIBER is given by;

$$P_L = P_o\, 10^{(-\alpha L/10)/dB}$$

Where,

Po is the launched power and α. Is the attenuation coefficient in decibels per unit length? "α" is the typical attenuation coefficient value for the FIBER under consideration here is 0.3dB per meter at a wavelength of 660nm. Loss in FIBERs expressed in decibels is given by –10log (P_o/P_F) where, Po is the launched power and P_F is power at the far end of the FIBER. Typical losses at connector junctions may vary from 0.3dB to 0.5 dB.

Losses in FIBERs occur at FIBER-FIBER joints or splices due to axial displacement, angular displacement, separation (airgap), mismatch of cores diameters, mismatch of numerical apertures, improper cleaving and polishing at the ends. The loss equation for a simple FIBER optic link is given as:

$$P_{in}\,(dBm) - P_{out}\,(dBm) = L_{J1} + L_{FIB1} + L_{J2} + L_{FIB2} + L_{J3}\,(dB)$$

Where,

L_{J1} (dB) is the loss at the LED-connector junction,

L_{FIB1} (dB) is the loss in cable1,

L_{J2} (dB) is the insertion loss at splice or in-line adaptor,

L_{FIB2} (dB) is the loss in cable2 and

L_{J3} (dB) is the loss at the connector-detector junction.

STEP – BY – STEP PROCEDURE: (WITH BLOCK SCHEMATIC)

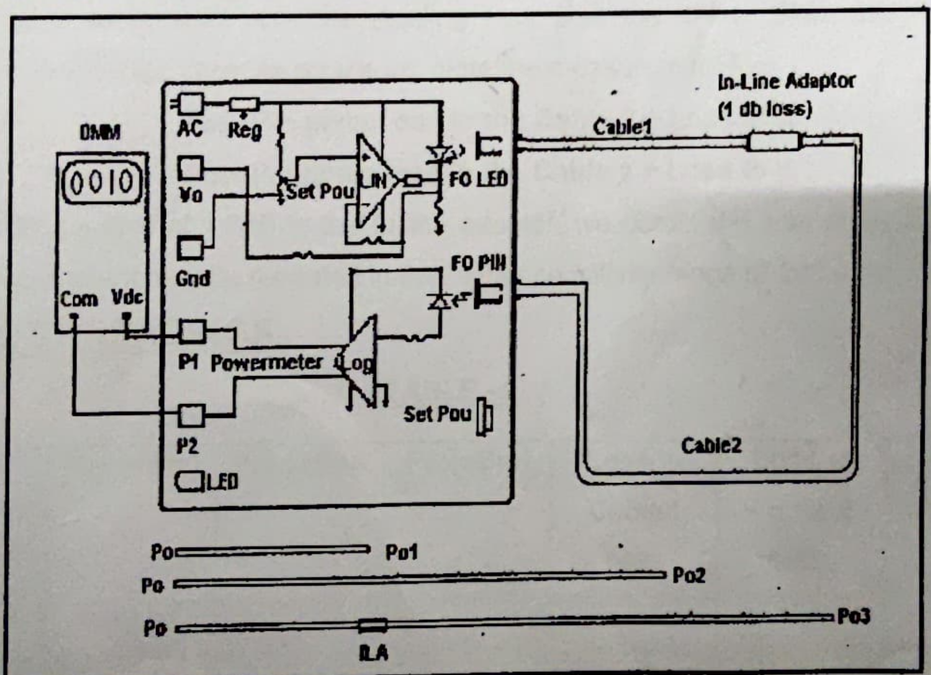

FIGURE - 4: THE SCHEMATIC DIAGRAM OF OPTICAL FIBER LOSS MEASUREMENT

1. Connect one end of FO Cable1 (1-Meter) to the FO LED on the FO LED port in the FIBER optic LED driver section and the other end to the FO detector in the optical power section.
2. Set the DMM to the 2000mV range. Connect the DMM V_{dc} to P1 and the DMM common P2. Turn the DMM ON. The power meter is now ready for use.
3. Switch ON the trainer. Connect the optical FIBER patch cord securely as shown, fiber relieving all twists and strains on the FIBER. Adjust the set P_{out} knob to set P_o to a suitable value say, -15.0dBm (the DMM will read 150 mV). Note this as P_{o1}.

4. Wind one turn of the FIBER on the mandrel as shown in experiment-1 and note the new reading of the power meter P_{O2}. Now the loss due to bending and strain on the plastic FIBER is P_{O1}-P_{O2}dB. For more accurate readout set the DMM to the 200.0mV range and take the measurement. Typically, the loss due to the strain and bending the FIBER is 0.3 to 0.8 dB.
5. Next remove the mandrel and relieve the cable of all twists and strains. Note the reading P_{O1} for cable 1 (1-meter cable). Repeat the measurement with the cable 2(5-meter cable) and note the reading P_{O2}. Use the in-line SMA adaptor and connect he cables in series as shown. Note the measurement P_{O3}.

P_{O3} - P_{O1} gives loss in the Cable 2 + Loss in IL.

P_{O3} - P_{O2} gives loss in the Cable 1 + Loss in IL.

Assuming a loss of 1.0dB in the in-line adaptor, we obtain the loss in each cable. The experiment may be repeated in the higher sensitivity range of 200.0mV.

TABLE OF READINGS:

TABLE –2

SL.NO	P_{O1} (dBm)	P_{O2} (dBm)	P_{O3}(dBm)	Loss in Cable1 (dB)	Loss in Cable 2 (dB)	Loss / meter (dB)
1	-15.0					
2	-20.0					
3	-25.0					
4	-30.0					

DISCUSSION:

The readings are close to the recorded readings.

WIRING DIAGRAM

EXPERIMENT - 2