Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil S. Gorivale
Roll No.	11
Practical No.	1
Title of Practical	Numerical Aperture of optical Fiber
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	4
Journal work and timely submission	10	8
Total	**20**	16

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Name of Faculty:

Signature:

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil . S. Gorivale
Roll No.	11
Practical No.	1
Title of Practical	Numerical Aperture of optical Fibers
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	4
Journal work and timely submission	10	8
Total	20	16

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Procedure:

- Make connections as shown in figure.
- Observe the illuminated circular patch of light on the screen.
- Measure exactly the distance d and also the vertical and horizontal diameters MR and PN as indicated in figure.
- Measure mean radius using the following formula $r = (MR+PN)/4$
- Find the numerical aperture of the fiber using the formula
  - $N.A. = \sin \theta_a = r/\sqrt{r^2+d^2}$
- Where θ_{amax} is the maximum angle at which the light incident is properly transmitted through the fiber.
- Vary the distance between screen and fiber optic cable and make it coincide with one of the concentric circles. Note its distance.

Observation Table:

Obs. No.	MR	PN	Distance(d)cm	Mean radius (r)	Numerical Aperture	Angle (θ_a)(Degree)
1	0.4	0.5	1	0.225	0.2195	12.67
2	0.9	0.8	2	0.425	0.2078	11.99
3	2	1.5	3	0.875	0.28	16.26

Conclusion: It was observed that as the distance decreases increases, the mean radius of the illuminated spot increases, changes NA & Angle slightly.

Post Experiment Questions:

- What is significance of Numerical Aperture? Why there any trade-off between NA and Data rate of optical fiber?

* Post Experiment Questions.

Q.1) i) The significance of numerical aperture is in determining the resolution, light gathering ability of imaging capabilities of optical system particularly in microscopy.

ii) It is a fundamental parameter for achieving high quality & detailed microscopic images.

iii) Dispersion is pulse broadening, which is not a good phenomenon because it affects the data rate.

iv) For numerical aperture, n_2 should be as low as possible, but for intermodal dispersion n_2 should be high as possible.

v) Thus, there is always trade off between numerical aperture & data rate of optical fibers.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil S. Gorivale
Roll No.	11
Practical No.	14
Title of Practical	To Plot the Refractive Index Profile
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	4
Journal work and timely submission	10	8
Total	**20**	16

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Depending upon mode of propagation and refractive index of the core, fibers are classified as:

- Step index-single mode fibers
- Step index-Multimode fibers
- Graded index-Multimode fibers

The optical fiber with a core of constant refractive index n1 and a cladding of a slightly lower refractive index n2 is known as step index fiber. This is because the refractive index profile for this type of fiber makes a step change at the Cylindrical fiber.

The refractive index profile of Step Index fiber may be defined as:

$$\eta(r) = \begin{cases} \eta 1 & r < a \text{ (Core)} \\ \eta 2 & r \geq a \text{ (Cladding)} \end{cases}$$

Graded index fibers do not have a constant refractive index in the core but a decreasing core index n(r) with radial distance from a maximum value of n1 at the axis to a constant value n2 beyond thecore radius a in the cladding. This index variation may be represented as:

$$\eta(r) = \begin{cases} \eta 1(1 - 2\Delta(\frac{r}{a})^{\alpha})^{\frac{1}{2}} & r < a \text{ (Core)} \\ \eta 1(1 - 2\Delta)^{\frac{1}{2}} = \eta 2 & r \geq a \text{ (Cladding)} \end{cases}$$

Where Δ is the relative refractive index difference and α is the profile parameter which gives the characteristic refractive index profile of the fiber core. The above equation which is a convenient method of expressing the refractive index profile of the fiber core as a variation of α allows representation of the step index profile when $\alpha = \infty$, a parabolic profile when $\alpha = 2$ and a triangular profile when $\alpha = 1$.

Result Analysis and Conclusion: From the two plots, conclusion

Step-index:- The refractive index is constant within core and abruptly decreases at the core boundary.

Graded-index:- The refractive index gradually decreases from the core boundary towards the cladding

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil . S. Gorvale
Roll No.	11
Practical No.	2
Title of Practical	Attenuation in optical fiber
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	4
Journal work and timely submission	10	8
Total	20	16

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Signature:

Procedure:

1. Connect the TechBook Power Supply with mains cord to TechBook Scientech 25
2. Make the connections as shown in next figure
3. Connect the Function Generator 1 KHz sine wave output to emitter input.
4. Connect 0.5 m optic fiber between emitter output and detector input.
5. Connect Detector output to amplifier input.
6. Put the mode switch SW1 to Analog to drive the emitter in analog mode.
7. Switch 'On' the Power Supply of TechBook and Oscilloscope.
8. Set the Oscilloscope channel 1 to 0.5 V/ Div and adjust 4-6 div amplitude by using X 1 probe with the help of variable potentiometer in Function Generator block at input of emitter.
9. Observe the output signal from detector on Oscilloscope.
10. Adjust the amplitude of the received signal as that of transmitted one with the help of gain adjusts pot in AC amplifier block. Note this amplitude and name it V1 .
11. Now replace the previous fiber optic cable with 1 m cable without disturbing any previous setting.
12. Measure the amplitude at the receiver side again at output of amplifier. Note this value end name it V2 .
13. Calculate the propagation (attenuation) loss with the help of following formula

$$\frac{V_1}{V_2} = e^{-\alpha(L_1 - L_2)}$$

Where

α = loss in nepers / meter

1 nepers = 8.686 dB

L_1 = length of shorter cable (0.5 m)

L_2 = Length of longer cable (1 m)

Conclusion: Hence, we have successfully measured propagation loss attenuation in optical fiber & verified by correlation between di... power of voltage.

Post Experiment questions:

Explain difference between attenuation and dispersion.

Procedure:

1. Connect the TechBook Power Supply with mains cord to TechBook Scientech 2...
2. Make the connections as shown in next figure
3. Connect the Function Generator 1 KHz sine wave output to emitter input.
4. Connect 0.5 m optic fiber between emitter output and detector input.
5. Connect Detector output to amplifier input.
6. Put the mode switch SW1 to Analog to drive the emitter in analog mode.
7. Switch 'On' the Power Supply of TechBook and Oscilloscope.
8. Set the Oscilloscope channel 1 to 0.5 V/ Div and adjust 4-6 div amplitude by using 1 probe with the help of variable potentiometer in Function Generator block at input of emitter.
9. Observe the output signal from detector on Oscilloscope.
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Conclusion: Hence, we have successfully measured propagation loss attenuation in optical fiber & verified by correlation between power of voltage.

Post Experiment questions:

Explain difference between attenuation and dispersion.

* calculations:-

Attenuation, $\alpha = \frac{10}{L_1 - L_2} \log_{10}\left(\frac{P_2}{P_1}\right)$

$L_1 \to$ length of fiber 1m.

$L_2 \to$ length of fiber 0.5m.

$P_1 \to$ Power when $L_1 = 1m$.

$P_2 \to$ Power when $L_2 = 0.5m$.

For 0.5m,

$V_2 = 0.8$

for 1m,

$V_1 = 1.4$

$\alpha = \frac{20}{1-0.5} \log\left(\frac{1.4}{0.8}\right)$

$\alpha = 9.72.$

Q.1. Explain the difference between attenuation and dispersion.

⇒ i) Attenuation → The gradual loss of optical signal power as it propagates through air fibers, mainly due to absorption, scattering and bending losses.

ii) Dispersion → The spreading of optical pulses overtime due to different propagation speeds of light modes (modal dispersion) or wavelength (chromatic dispersion) leading to signal distortion.

Q.2) How to measure propagation losses?

⇒ i) Cut-Back Method :- Measures input and output power before and after cutting a short length of fiber.

ii) Optical Time-Domain Reflectometer : Sends a pulse into the fiber and analyses backscattered signals to determine loss.

iii) Insertion loss method :- Compares transmitted power before and after inserting the fiber into a system.

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Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil S. Gorivale
Roll No.	11
Practical No.	4
Title of Practical	Bending losses in Optical fiber
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	5
Understanding	5	4
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Signature:

Procedure:

1. Connect the TechBook power supply with the main cord to the TechBook Scientech 2501A.
2. Make the connections as shown in the diagram.
3. Connect the function generator (1V, 1 KHz) sine wave output to emitter input.
4. Connect 1 m optic fiber between emitter output and detector input.
5. Connect detector output to amplifier input.
6. Put the mode switch SW1 to analog to drive the emitter to analog mode.
7. Switch ON the power supply of TechBook and oscilloscope.
8. Touch the power symbol for a few seconds to switch ON the TechBook. The power symbol is given at top left-side position.
9. Adjust the amplitude of the received signal as that of the transmitted one with the help of gain adjusts potentiometer in the AC amplifier block. Note this amplitude name it V1.
10. Wind the fiber optic cable on the Mondtel and observe the corresponding AC amplifier output on the oscilloscope, it will be gradually reducing, showing loss due to bends.
11. Observe the output signal from the detector on an oscilloscope.

Observation Table: Vin =__

Number of turns	Output voltage Vo (v)
1	0.8
2	0.28
3	0.22

Result analysis and Conclusion: Hence, we have successfully measured the bending in an optical fiber, the output voltage of turns. We observed that as no. of turns are the bends increases the output voltage

Post experiment questions:

1. Explain your understanding of radius of curvature in optical communication.
2. What is the reason for bending losses?

Q.1) Explain your understanding of radius of curvature in optical communication.

=> It refers to the radius of the arc that an optical fiber bends into. A small radius indicates a sharper bend, which can cause signal loss due to leakage of light from the core to the cladding. Maintaining a large radius minimizes bending losses and preserves signal integrity.

Q.2) What is the reason for bending losses?

=> 1) Macrobending losses :- Occur when the fiber bends beyond its critical radius, causing light to escape from the core.

2) Micro bending losses :- Results from small random bends due to mechanical stress leading to scattering & attenuation.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sakil S. Gorivale
Roll No.	11
Practical No.	12
Title of Practical	To Measure Bit Error Rate
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	5
Understanding	5	4
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Signature:

- Connect the 64 KHz Clock from the Clock generator to the Clock in the socket of the Data generator.
- Connect the Data Generator output to the emitter input.
- Connect the fiber optic cable between the emitter output and detector input.
- Connect the detector output to the 'Signal In' socket of the Noise Generator.
- Put the selection switch towards the Bit Error Counter Block to count the bit error.
- Put the mode switch SW1 to Digital to drive the emitter in Digital mode. This ensures that the signal applied to the driver input causes the emitter LED to switch quickly between the 'On' & 'Off' states.
- Switch 'On' the Power Supply of TechBook and Oscilloscope.
- Initially Adjust the Level pot of the Noise Generator at the middle position.
- Press the Start/Stop switch and observe the Error Count on the 7-Segment Display of Bit Error Counter for any time duration 'Td' and press the Start/Stop switch again to stop.
- Record the readings for different clock frequencies/Time duration/Noise levels in the following observation table.
- Adjust the Level pot for minimum and maximum positions to observe the effect of variable noise on the error count.

Measuring Bit Error Rate

A BERT (bit error rate tester) is a procedure or device that measures the BER for a given transmission. The BER, or quality of the digital link, is calculated from the number of bits received with error divided by the number of bits transmitted.

BER= Bits received with Error /Total bits transmitted.

Observation Table 1:

Sr No	Clock Frequency (CLK)	Time Duration (Td)	Total no. of transmitted bits N=CLK*Td	Bit Error Count (E)	Bit Error Rate=E/N
1	64	5s	64x5 = 320	59	5.42
2	128	5s	125x5 = 625	127	4.921
3	256	5s	256x5 = 1280	211	2.96

Observation Table 2:

Sr No	Clock Frequency (CLK)	Time Duration (Td)	Total no. of transmitted bits N=CLK*Td	Bit Error Count (E)	Bit Error Rate=E/N
1	256	5	1280	214	5.98
2	256	10	2560	424	6.03
3	256	15	3840	605	6.34

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Result Analysis and Conclusion: From observation table 1, as the clock freq. increases, the total no. of transmitted bits increases, BEC also increases with the freq. BER, however, shows a decreasing trend as the freq increases. From observation table 2, BEC(E) also increases with time which means over extended durations, accumulated noise leads to increasing BER.

Post Experiment Question:

1. Discuss the trade-off between bandwidth and Bit Error Rate.

2. What is the significance of BER in designing reliable communication systems?

Q.1) Discuss the trade-off between bandwidth and Bit Error Rate.
=) In digital communication system, bandwidth and BER are two critical performance parameters that often compete with each other.
ii) While higher bandwidth can reduce BER by supporting robust modulation schemes, it also introduces noise & interferences.
iii) Reducing bandwidth may increase BER if higher-order modulations are needed. Effective system design must balance these factors to ensure reliable and efficient communication.

Q.2) What is the significance of BER in designing reliable communications systems?
=) i) Quality Measurement: BER indicates the reliability of a communication link, helping in system evaluation.
ii) Error Control: Higher BER requires stronger error correction methods like forward error ~~cor~~ correction (FEC) to maintain data integrity.
iii) Network Performance: In digital communication, low BER ensures minimal retransmission reducing latency and improving efficiency.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	B.E	Semester:	VIII
Course Code:	ECL 801	Course Name:	OCN

Name of Student:	Sahil S Gorivale
Roll No.:	11
Experiment No.:	6
Title of Experiment:	V-I Characteristics of Photo LED
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	5
Understanding	5	4
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-4	1-2
Understanding	4-5	2-4	1-2
Journal work and timely submission	8-10	6-8	2-4

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Name of Faculty:

Signature:

Date:

Procedure:

1. Connect the TechBook Power Supply with mains cord to TechBook Scientech 2501A.
2. Ensure that all switched faults are in OFF condition.
3. Put the mode switch SW1 to Digital to drive the emitter in Digital mode.
4. Make connections as shown in the above figure
5. Connect the variable Power Supply 1 to the emitter input.
6. Keep the level of the supply to minimum position.
7. Connect an Ammeter between point 'a' and 'b' to measure the forward current (If).
8. Connect a Voltmeter between emitter input and variable Power Supply 2 to measure the forward voltage (Vf).
9. Keep the level of the supply to maximum position. It measures the voltage drop across the 1kohms (connected in series with Photo LED) current limiting resistors.
10. Switch 'On' the Power Supply of TechBook and Oscilloscope.
11. Adjust the Power Supply potentiometer to its minimum setting fully counter clockwise.
12. Now look down the emitter LED socket and slowly advance the setting of the potentiometer until in subdued lighting the light from LED is just visible.
13. Vary the potentiometer gradually so as to vary the forward voltage (as 1.5, 2.0.....), note the corresponding If (forward current).
14. Record these values of (Vf) and (If) & plot the characteristic between these two.

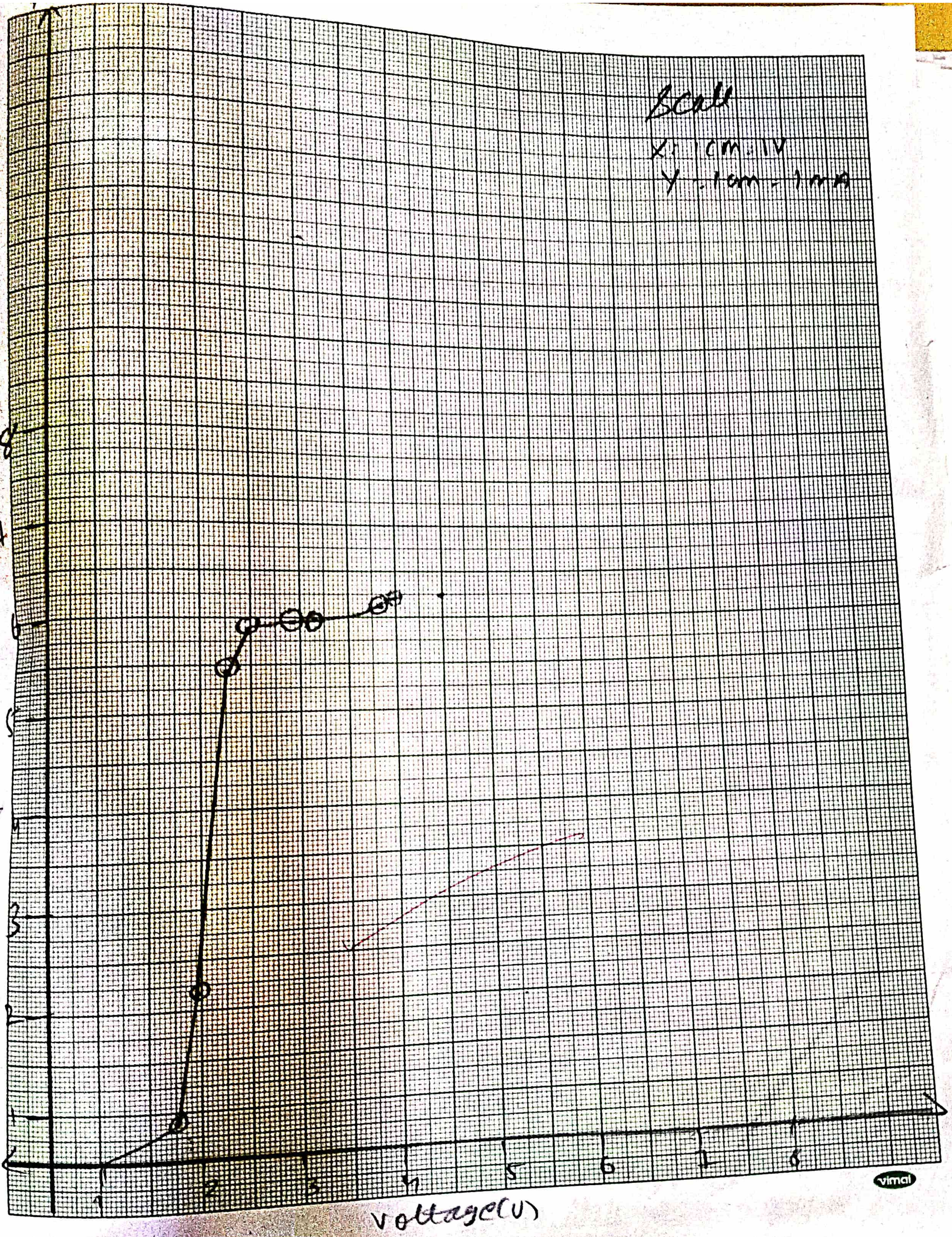
Observation Table:

Sr No	Voltage (Vf)	If(mA)
1	1.8	0.77
2	1.98	2.17
3	2.13	8.4
4	2.36	5.89
5	2.7	5.96
6	3.01	6
7	3.85	6.01
8	4	6.04

9	5	6.04

Conclusion: In conclusion, the experiment to study the characteristics of photo LED has successfully high lighted intensities & frequency the linear relationship between voltage & current within a certain range, confirms the photo LEDs efficiency in converting electrical energy into light.

Post Experiment Question: Write minimum four points for Comparison between Spontaneous and Simulated emission.



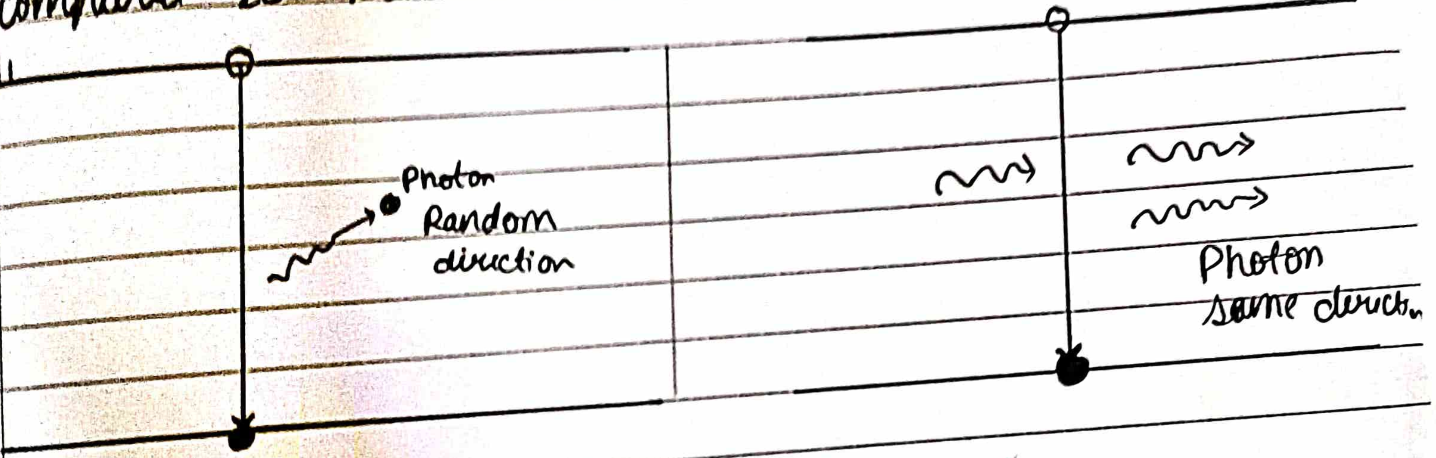
11

Exp 4:

Q) Write minimum four points for comparison between spontaneous & stimulated emission.

A) i) Spontaneous Emission:
- occurs without influence with atoms releasing photons randomly as they return to lower energy.
- The emitted photons are in coherence with random phases of directions.
- It is the primary process in light emitting diodes LED certain types of lasers during their phases.
- Does not require population inversion & is less controlled compared to stimulated emission

ii



iii) Stimulated emission:
- Requires an external photon to trigger the emission of additional photon that are coherent with the triggering photon.
- Results in an amplifier light beam which is the fundamental of operation of lasers.
- Unlike spontaneous emission, which occurs randomly, stimulated emission is a controlled and predictable process that requires a condition known as population inversion where more atoms are in excited state than in ground state.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	B.E	Semester:	VIII
Course Code:	ECL801	Course Name:	OCN

Name of Student:	Sahil S. Gorivale
Roll No.:	11
Experiment No.:	7
Title of Experiment:	V-I Characteristics of Photo Detector
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	5
Understanding	5	4
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-4	1-2
Understanding	4-5	2-4	1-2
Journal work and timely submission	8-10	6-8	2-4

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Signature:

Date:

4. Make connections as shown in next figure
5. Connect the variable Power Supply 1 to the emitter input.
6. Keep the level of the supply to minimum position.
7. Connect a patch cord between point 'a' and 'b'.
8. Connect the fiber optic cable between emitter output and detectors input.
9. Connect a Voltmeter between emitter input and variable Power Supply 2 to measure the forward voltage (Vf).
10. Keep the level of the supply to maximum position.
11. It measures the voltage drop across the 1kohms (connected in series with Photo LED) current limiting resistors.
12. Connect an Ammeter between point 'c' and 'd' to measure the detector current (Id). · Switch 'On' the Power Supply of TechBook and Oscilloscope.
13. Adjust the Power Supply potentiometer to its minimum setting fully counter clockwise.
14. Now look down the emitter LED socket and slowly advance the setting of the potentiometer until in subdued lighting the light from LED is just visible.
15. Vary the potentiometer gradually so as to vary the forward voltage and note the corresponding detector current (Id).
16. Record these values of (Vf) and (Id) & plot the characteristic between these two.

Observations:

Sr No	Voltage (Vf)	Id(mA)
1	1.05	0.21
2	1.51	0.35
3	1.58	0.46
4	1.61	0.78
5	1.7	3.19

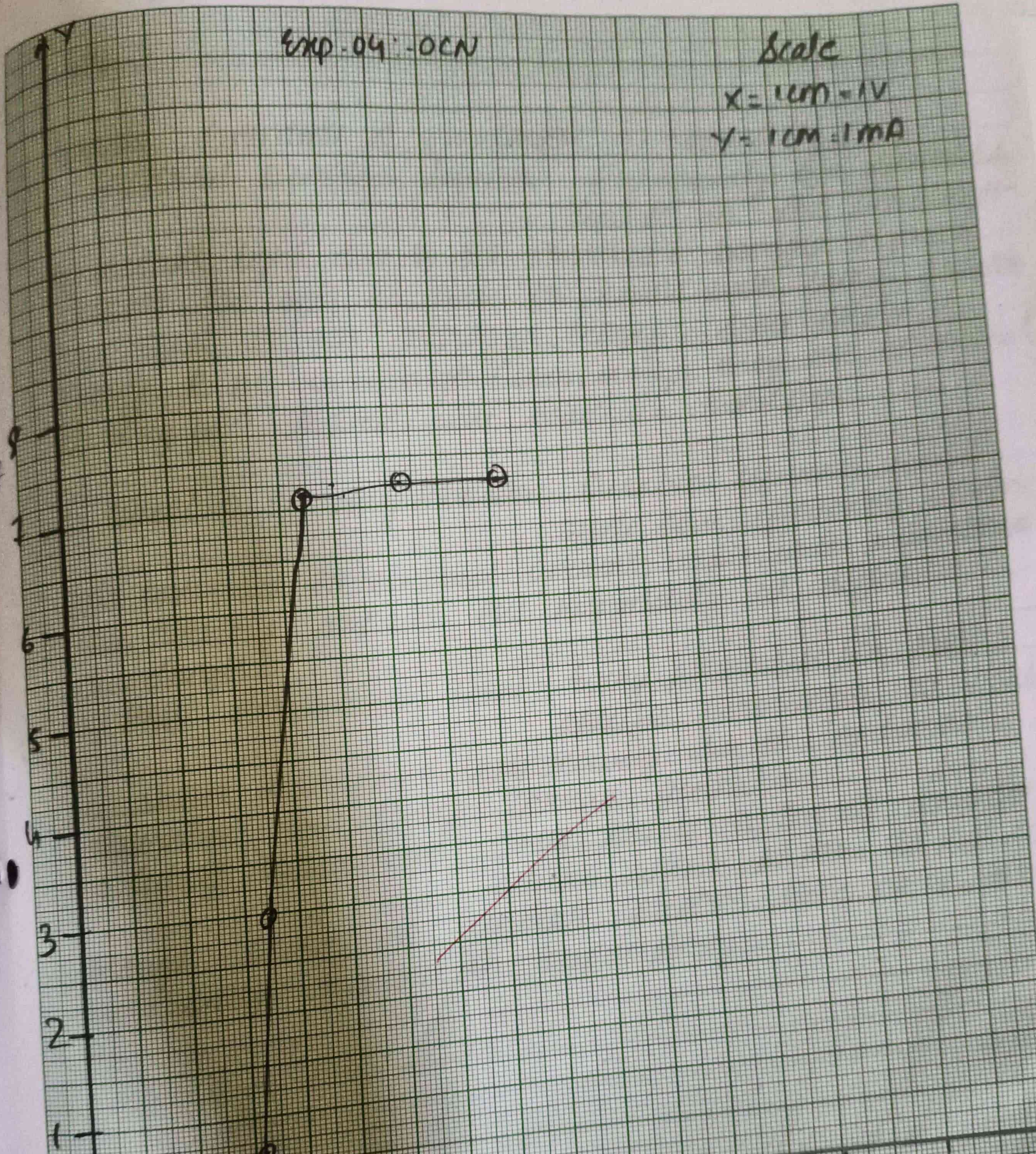
6	2.28	~~0.21~~ 7.31
7	3.3	~~0.35~~ 7.3
8	2.65	7.3
9	4.2	7.3

Conclusion: It demonstrated the response to light intensity & wavelength

Post Experiment Questions:

Explain dependence of wavelength on responsivity

Conclusion: The readings indicate that photodetector output current is directly proportional to the incident light intensity. The photodectors sensitivity to different wavelength which is crucial for applications requiring spectral discrimination.


Exp-04:-OCN
Scale
X = 1cm = 1V
Y = 1cm = 1mA
Y
1
2
3
4
5
6
7
8
1
2
3
4
5
6
7
8
voltage(V)

Exp 5

Q] Explain dependence of wavelength on responsivity

→ i] Material bandgap Influence: Responsivity of a photodetector depends on the wavelength of incident light due to the material's bandgap. A photo-detector can only responds to photons with energy greater than equal to the bandgap energy. Since photon energy $E = hc$ wavelength (lower energy) may not be detected if they fall below the material's bandgap.

ii] Quantum Efficiency Variation: Quantum efficiency, which affects how efficiently photons are converted to electrical current, varies with wavelength. This directly impacts the responsivity at different wavelengths.

iii] Peak Responsivity Point: Every photodetector has a specific wavelength at which it shows maximum responsivity due to optimal absorption and charge carrier generation.

iv] Cut-off Wavelength: There exists a cut-off wavelength beyond which photons do not have enough energy to generate electron-hole pairs, resulting in a sharp decrease in responsivity.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class		Semester	
Course Code		Course Name	

Name of Student	Sahil . S. Gorivale
Roll No.	11
Practical No.	11
Title of Practical	Dispersion Compensation
Date of Performance	
Date of Correction	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	5
Journal work and timely submission	10	9
Total	**20**	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-3	1-2
Understanding	4-5	2-3	1-2
Journal work and timely submission	8-10	6-7	2-3

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Name of Faculty:

Signature:

Q.9) Dispersion hamper information carrying capacity of fiber. Justify.

→ i) Dispersion causes pulse broadening leading to inter-symbol interference (ISI), which limits the maximum data rate.

ii) Higher dispersion reduces signal clarity, requiring lower transmission speeds or complex compensation techniques.

iii) In long-haul communication, dispersion management is crucial to maintain high-speed data transmission.

Q.10) What is the impact of distance on length of the fiber.

→ 1) Longer distances increase attenuation and dispersion, degrading signal quality.

2) Requires signal amplification or regeneration using optical amplifiers or repeaters.

3) Overall system Design, including power budget, modulation schemes, and error ~~cor~~ correction techniques

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	B.E	Semester:	VIII
Course Code:	ECL801	Course Name:	OCN

Name of Student:	Sahil S Gorivale
Roll No.:	11
Experiment No.:	9
Title of Experiment:	Link Power Budget
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	5
Understanding	5	4
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-4	1-2
Understanding	4-5	2-4	1-2
Journal work and timely submission	8-10	6-8	2-4

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αf is the fiber attenuation in (dB/km)
and L is the transmission length in km
System margin is normally taken 6dB for LED and 8 dB for ILD.

Conclusion: The experiment used a Matlab program to calculate the maximum length of an optical fiber line based on input power, receiver sensitivity fiber attenuation, splice loss, connector loss, and safety margin with the given value the maximum link length was calculated as 53.33 Km.

Post Experiment Question: What is significance of Link Power Budget

Link Power Budget

Q) P_t = Transmitted power = -11dBm
P_r = Received sensitivity = -44 dBm.
Safety margin = 7dB = Sm
Fiber loss = 0.2 dB/Km = α_f
Splice loss = 0.4 dB/Km = L_{sp}
Connector loss = 1dB = L_c

i) Find the maximum link length.

Total allowed power loss = $P_T = P_t - P_r$
$= -11 - (-44)$
$P_T = 33$ dBm

$P_T = (\alpha_f * L) + L_{sp} * L + Sm + L_c$
$33 = (0.2 \times L) + (0.4 \times L) + 7 + 2(1)$
$L = 39.9$ Km.

ii) With dispersion penalty of 1.5dB.

$P_T = (\alpha_f \times L) + L_{sp} \times L + Sm + 2L_c + d_p$.
$33 = (0.2 \times L) + (0.4 \times L) + 7 + 2(1) + 1.5$
$33 = 0.6L + 10.5$
$L = 37.9$ Km.

∴ The maximum possible link length is 39.9 Km.
1.5 dB dispersion penalty is 37.9Km.
∴ We got reduction of 2Km.

Q) What is significance of link Power budget.

→ The link Power budget is a critical concept in optical and wireless communication system that determines whether the transmitted signal will be strong enough to be received effectively after accounting for all losses in the communication path.

1) Ensures Reliable Communication
2) Ensure future scalability.
3) Optimizes component selection
4) Supports Maintenance and Troubleshooting

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	B.E	Semester:	VIII
Course Code:	ECL801	Course Name:	OCN

Name of Student:	Salil. S. Goriwale
Roll No.:	11
Experiment No.:	10
Title of Experiment:	Rise Time Budget
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	5
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-4	1-2
Understanding	4-5	2-4	1-2
Journal work and timely submission	8-10	6-8	2-4

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t_{modal}= modal dispersion of the fiber
t_{mat}= Material dispersion rise time

Conclusion: For a 14 km fiber, the total system rise time was 11.25 ns. The bit rat were 62.36 Mbps (NRZ) and 31.18 Mbps (RZ). Higher rise time limits bit rate, showing the importance of system optimization.

Post Experiment Question: What is significance of Rise time Budget.

Rise time Budget

Q) An optical fiber system is to design over ~~8km~~ 11km length without repeater the rise time of component are LED = 8ns PIN PD = 6ns, fiber intermodal = 5ns/km & intramodal = 1ns/km. Calculate the maximum bit rate that may be achieve on the link using NRZ format. Compare it with RZ format.

→ Given: $t_{source} = 8ns$

$t_{detector} = 6ns$

$t_{fiber} = t_{intermodal} = 5 ns/km$

$t_{intramodal} = 1ns/km$

$l = 11 km$ (rollno)

We know that,

$$t_{sys} = \sqrt{11^2 + (5 \times 11)^2 + (1 \times 11)^2 + (6)^2}$$

$$= 56.9737$$

For NRZ,

Bit rate $= 0.7/t_{sys} = 12.28$ Mbps

For RZ,

Bit rate $= 0.35/t_{sys} = 6.14$ Mbps

Q) What is significance of Rise time Budget?
=) The rise time Budget is essential in high-speed digital and optical communication system because it determines how fast the system can transmit data without signal distortion or intersymbol interference.

Key significance:

1) Ensures Accurate Data Transmission
2) Determines Maximum Data Rate
3) Aids in troubleshooting & Upgrades
4) Combines effects from all components.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	B.E	Semester:	VIII
Course Code:	ECL801	Course Name:	OCN

Name of Student:	Sahil. S. Goriwal.
Roll No.:	11
Experiment No.:	11
Title of Experiment:	Characteristics of FBG
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Performance	5	4
Understanding	5	5
Journal work and timely submission	10	9
Total	20	18

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Performance	4-5	2-4	1-2
Understanding	4-5	2-4	1-2
Journal work and timely submission	8-10	6-8	2-4

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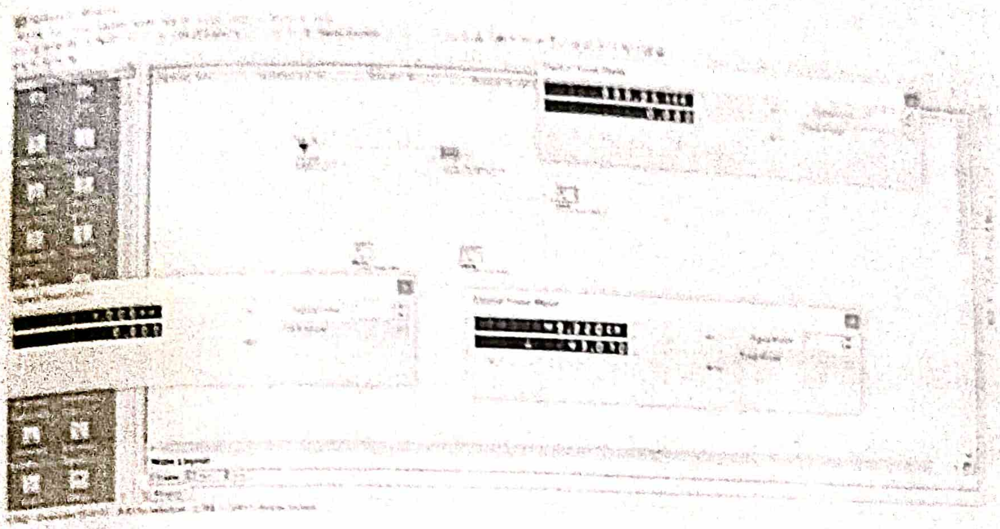
Name of Faculty:

Signature:

Date:

8. Observe the reading in power meter (Input power, Reflected Power and Transmitted Power) and note down it.



9. Repeat simulation for 1510 nm, 1550 nm and 1570 nm.

10. Complete the Observation Table.

Observation Table:

Sr. No.	Wavelength (nm)	Input Power, P1	Reflected Power	Transmitted Power, P2	Reflectivity, $R = \frac{P1-P2}{P1} * 100$
1	1510	1.00×10^{-3}	0	1.00×10^{-3}	0%
2	1530	1.00×10^{-3}	0	1.00×10^{-3}	0%
3	1550	1.00×10^{-3}	147.826×10^{-6}	852.174×10^{-6}	14.78%
4	1570	1.00×10^{-3}	5×10^{-9}	999.995×10^{-6}	0.0005%

Result Analysis and Discussion: - In this experiment the reflectivity was highest at 1550 nm (14.78%), indicating strong back reflection at 1510 nm, 1530 nm and 1570 nm, the reflectivity was nearly 0%, showing efficient transmission at non-Bragg wavelength.

Conclusion: The experiment confirms that FBG reflects only the Bragg wavelength (1550 nm) while transmitting other, demonstration its effectiveness as a wavelength optical fiber.

Vidyavardhini's College of Engineering & Technology

Department of Electronics and Telecommunication Engineering

Academic Year 2024-25

Class:	BE	Semester:	VIII
Course Code:	ECL801	Course Name:	OCN

Name of Student:	Sahil S. Gorivale
Roll No.:	11
Assignment No.:	3
Title of Assignment:	
Date of Submission:	
Date of Correction:	

Evaluation

Performance Indicator	Max. Marks	Marks Obtained
Legibility	4	4
Demonstrated Knowledge	4	3
Timely submission	2	2
Total	10	9

Performance Indicator	Exceed Expectations (EE)	Meet Expectations (ME)	Below Expectations (BE)
Legibility	4	2-3	1-2
Demonstrated Knowledge	4	2-3	1-2
Timely submission	2	1	1

Checked by

Name of Faculty:

Signature:

Date:

Q) The following parameter are established for a long-haul single mode optical fiber operating at a wavelength of 1.3 μm.
Mean power launched from the laser transmitter is 3dBm
Cable fiber loss 0.4 dB/Km.
Splice loss 0.1dB/Km
Connector losses at the transmitter and receiver 1dB each
Mean power required at the APD receiver when operating at 35 Mbps is -55 dBm
when operating at 400 Mbps is -44 dBm
Required safety margin 7dB
Estimate
a) The max. possible link length without repeaters when operating at 35 Mbps.
b) The max possible link length without repeaters when operating at 400 Mbps.
c) The reduction in the max possible link length without repeaters of (b) when there it is a dispersion equalization penalty of 1.5dB. It may be assumed for the purpose of these estimate that the reduced link length has 1.5dB penalty.

=) Given:

$P_C = -3dBm$

$\alpha_f = 0.4 dB/Km$

$l_{sp} = 0.1 dB/Km$

$l_C = 1dB$

35 Mbps, $P_R = -55$ dBm

400 Mbps, $P_R = -44$ dBm
$M = 7$ dB

a) $L = ?$
Total loss, $P_T = P_C - P_R$
$= -3 - (-55)$
$= 52$ dB

$P_T = (\alpha_f \times L) + 2l_c + (l_{sp} \times L) + M$
$52 = (0.4 \times L) + (2 \times 1) + (0.1 \times L) + 7$
$52 = 0.5L + 9$
$\therefore L = 86$

b) $L = ?$ when $P_R = -44$ dBm

Total loss, $P_T = P_C - P_R$
$= -3 - (-44)$
$= 41$ dB

$P_T = (\alpha_f \times L) + 2l_c + (l_{sp} \times L) + M$
$41 = (0.4 \times L) + (2 \times 1) + (0.1 \times L) + 7$
$L = 64$

c) $L = ?$ where $P_R = -44 dBm$
Dispersion equlization finding
Total loss, $P_T = P_C - P_R$
$= -3 - (-44)$
$= 41 dB.$

$P_T = (\alpha_f \times L) + 2l_c + (l_{sp} \times L) + M + DEP$
$41 = 0.4 \times L) + (2 \times 1) + (0.1 \times L) + 7 + 1.5$
$41 = (0.4 \times 0.1) \times L + 2 + 7 + 1.5$

$\therefore L = 61 Km.$

There is reduction in fiber length by 3Km, when dispersion equalization penalty was added.