**UNIT – IV**

**Session: 1**

1. **Recap: Matching the keyword – PPT slides**

Learners have to identify the perfect match and the facilitator verifies for the answer & finally the animated match is displayed for the learners to verify the answer

1. **Digital signal transmission– PPT slides**

www.electronics.dit.ie/staff/tfreir/optical\_2/Unit\_3.ppt‎

Explanation for digital transmission operation of each and every block

1. **Receiver operation – PPT slides**

Explanation for the typical optical receiver

1. **Conclusion: Recall by Questions**

**Sample questions:**

1. What type of modulation is used ?
2. What are the optical sources?
3. The noise that follows poisson ’ s process is-------------
4. List the mechanism that affect signal

**Session: 2**

1. **Recap: Summarization**

The summary of last session is given by the facilitator.

1. **Pre amplifier - chalk & talk/PPT slides**

Low impedance, high impedance & Trans impedance preamplifier

Need for transmission in optical fiber.

BJT Preamplifier

1. **FET Preamplifier – chalk & talk / PPT slides**
2. **Conclusion: Recall by Questions**

Sample questions are

* 1. What is a preamplifier?
  2. What is the need for it?
  3. Low impedance amplifier -comment
  4. High impedance amplifier- comment

**Session: 3**

1. **Recap: Keyword game:**

Keywords given in the form checker box learner has to identify the keyword and tell about it.

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| **R** | **Z** | **N** | **H** | **I** | **P** | **Y** | **T** | **B** | **C** | **R** |
| **E** | **X** | **S** | **Q** | **W** | **E** | **V** | **F** | **L** | **P** | **A** |
| **A** | **T** | **T** | **E** | **N** | **U** | **A** | **T** | **I** | **O** | **N** |
| **M** | **A** | **C** | **Y** | **N** | **M** | **L** | **H** | **T** | **D** | **S** |
| **P** | **M** | **F** | **L** | **S** | **U** | **C** | **Z** | **X** | **Q** | **I** |
| **L** | **A** | **S** | **E** | **A** | **I** | **H** | **L** | **P** | **H** | **M** |
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Sample keyword

LED- Optical source for multimode fiber

Long lifetime

Cheap

Dispersion is more

1. **Error sources: PPT slides/chalk & talk**

Dark current noise, quantum noise, surface leakage current noise

1. **System design consideration – chalk & talk**

classes.soe.ucsc.edu/ee230/Spring04/Lecture%207.ppt

1. **Conclusion: Learner led presentation**

One of the learner is asked to give a presentation on the topic discussed.

**Session: 4**

1. **Recap: Tit for Tat**

Each group is given 3 mins to prepare 2 questions. One group will ask the other and vice versa.

Sample questions are

1. Mention the error sources
2. What is surface leakage current ?
3. What is ISI?
4. What are the effects of noise sources?
5. **Basic receiver Configuration: PPT/slides**

Function of equalizer and preamplifier

seminarprojects.com/s/optical-fiber-measurements-ppt‎

1. **Probability of error: - PPT slides**

The probability of error is derived to determine the optical receiver performance**.**

The BER for OFC is 10-9 to 10-12 is one error occur for every 1 billion pulses sent**.**

classes.soe.ucsc.edu/ee230/Winter06/Lecture%2017.**ppt**

classes.soe.ucsc.edu/ee230/Spring04/Lecture%2012.**ppt**

1. **Conclusion: Question & Answer**

Facilitator randomly asks the learner.

1. BER for optical receiver is ----------
2. Define Quantum limit
3. Give the error function
4. Define BER

**Session: 5**

**1.Attenuation in fiber: Recalling it from unit – II**

1. attenuation / unit length is ------------
2. What are the causes for attenuation?
3. What are the attenuation mechanism?

**2. Absorption loss, scattering loss measurement – PPT slides**

<http://electron6.phys.utk.edu/optics421/modules/m8/optical_fiber_measurements.htm>

Attenuation measurement – cut back technique

Absorption Loss measurement – Thermo couple

3. S**cattering Loss measurement – using solar cell– PPT slides**

<http://course.ee.ust.hk/elec342/notes/Lecture%206_attenuation%20and%20dispersion.pdf>

Cube of six solar cells or intergrating sphere scattering cell**.**

**4 .Conclusion: Quiz**

Questions were prepared by the learners. Facilitator combines the question and asks the groups and records the score.

1. What is a chopper?
2. What is the use of index matching fluid?
3. Given the meaning of Thermocouple.

**Session: 6**

1. **Recap: Jumbled word**

Facilitator lists the jumbled word and asks the learner to find the correct word and discuss about it

1. hornmtoarotorcom - monochromator
2. prdeclimongstradi ped - cladding mode stripper
3. berodecsmrlam - mode scrambler
4. nentsifreiterlfecer. – interference filter
5. **Fiber dispersion measurement: PPT slides**

<http://lib.tkk.fi/Diss/2002/isbn9512259869/isbn9512259869.pdf>

Time domain measurement and frequency domain measurement

Measurement of dispersion in multimode fiber in the time domain

1. **Frequency domain measurement: PPT slides**

Swept frequency measurement method.

1. **Conclusion : Summarization by facilitator**

Facilitator summarizes the impulse response measurement and frequency response measurement

**Session: 7**

1. **Recap: Question and Answer**

Facilitator randomly asks the questions

1. What is meant by delay distortion?
2. List the mechanisms that causes dispersion – material, waveguide, intermodal
3. What are the methods used to measure fiber dispersion?
4. **Refractive index profile measurement: PPT slides**

<http://www.itl-lab.com/english/abilityintroduction2.php?id=20>

Recall the refractive index profile for step index and graded index fiber and importance of refractive index profile

1. **Interferometer method, Near field scanning method: PPT slides**

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CDAQFjAB&url=http%3A%2F%2Fwww.corning.com%2FWorkArea%2Fdownloadasset.aspx%3Fid%3D7907&ei=i2_UUaKfLImPrge38IHQCA&usg=AFQjCNGaYtKgVmymBevK0sCbhgosT-mPfQ&sig2=0uT5jeeVvKVZKcivSTPyow>

Reflected light interferometer

Refracted near field method for measurement of RI profile

1. **Conclusion: Fill Ups**

**1.R**efractive index profile allows the determination of --------------&--------------.

2.The fringe shift is------------

3.The methods used for the measurement of RI profile are -----------,-----------,------------

**Session: 8**

1. **Recap: Question and Answer**

Facilitator asks randomly the learners

1. What is the importance of RI profile?
2. What are the techniques used for RI profile measurement?
3. Which method is widely used?
4. **Fiber cutoff wavelength measurement: chalk and talk**

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CDAQFjAB&url=http%3A%2F%2Fwww.corning.com%2FWorkArea%2Fdownloadasset.aspx%3Fid%3D7907&ei=i2_UUaKfLImPrge38IHQCA&usg=AFQjCNGaYtKgVmymBevK0sCbhgosT-mPfQ&sig2=0uT5jeeVvKVZKcivSTPyow>

Measurement of un cabled fiber cut off wavelength -Single turn method and Split mandrel

1. **Spot size technique, power step technique: chalk and talk**
2. **Conclusion: Recall by keywords**

**List of keywords**

Cutoff wavelength

Guided modes

Parabolic profile

Effective cutoff wavelength

**Session: 9**

1. **Recap: Question and Answers**

The following questions can be asked to ensure that, the learners have gained a good understanding of the concepts discussed so far.

* 1. Give number of guided modes for graded index
  2. Define effective cutoff wavelength
  3. What are guided modes?

1. **Numerical aperture measurement:- PPT slides**

<https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&sqi=2&ved=0CCsQFjAA&url=http%3A%2F%2Fwww.corning.com%2FWorkArea%2Fdownloadasset.aspx%3Fid%3D7917&ei=EW_UUebNOcbprAeDw4H4BA&usg=AFQjCNFRbgdY1OVxKH90O1-w-DQdjuaydg&sig2=Lqy3byODyjdFBNWAiib69A>

Measurement using scanning photo detector and Trigonometric method

1. **Fiber outer diameter and core diameter measurement: - PPT slides**

<http://www.nist.gov/calibrations/upload/ao37-24.pdf>

Shadow method and core diameter measurement

1. **Conclusion: Pick and Answer**

A grid is prepared with 4 questions each grid is named by a number. Learner has to pick one number and has to identify the answer for the questions and correct answers are verified from the slide.

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| 1 | 2 |
| 3 | 4 |